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Leaching a Copper Mine

The Ohio Copper Co. uses a novel method of working its deposits and becomes one of the lowest cost producers in the United States

By Felix Edgar Wormser

Recent Flotation Litigation

By T. A. Rickard

Pre-Cambrian Veins of Kirkland Lake

By J. E. Spurr

M.I.T.'s New Summer Camp for Mining Students

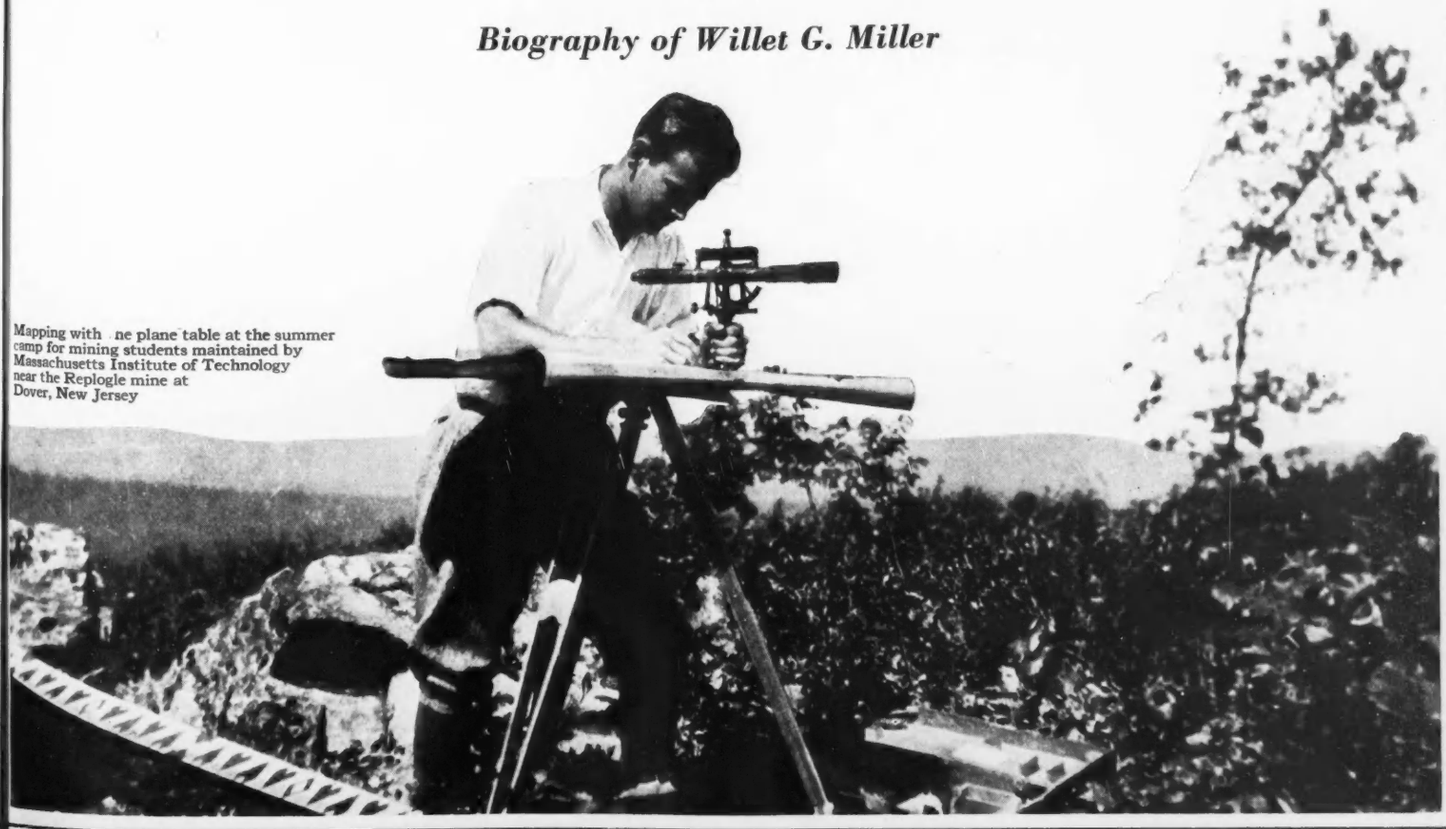
By A. H. Hubbell

Centrifugal Force in Ore Dressing

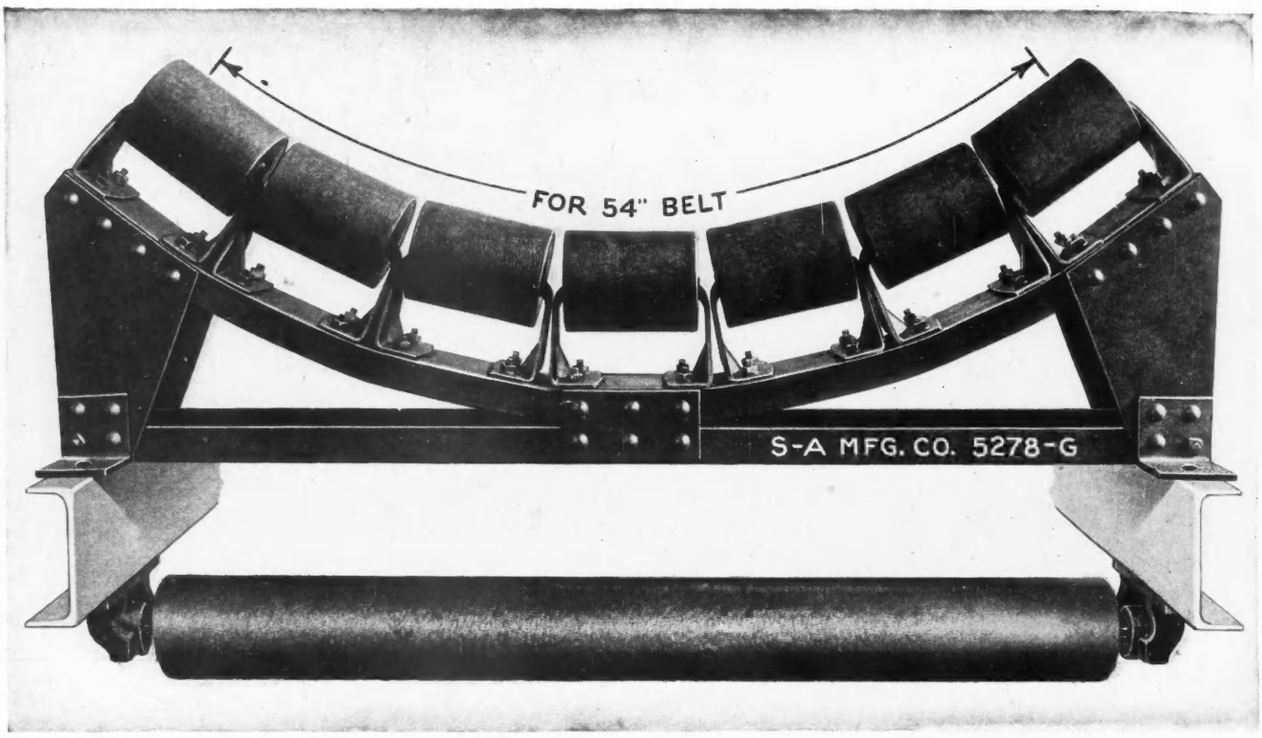
Six distinct uses are considered by the author, who has been studying the subject for the U. S. Bureau of Mines

By Oliver C. Ralston

Biography of Willet G. Miller



Mapping with the plane table at the summer camp for mining students maintained by Massachusetts Institute of Technology near the Replogle mine at Dover, New Jersey



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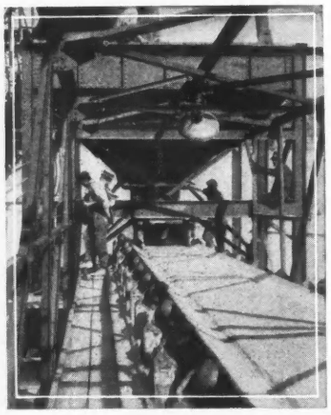

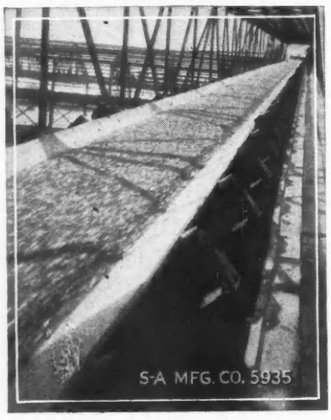

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ENGINEERING & MINING
JOURNAL-PRESS
JOSIAH EDWARD SPURR, Editor

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Help From the Government

THOSE OF US who are in the habit of looking to the government to "do something" for us or for our business, especially those who are calling for bonuses to be paid out of government funds, or who are clamoring for a commission to investigate this or recommend that which we believe will give us personally greater profits and an easier life, would do well once in a while to pause and consider how much of a government plant we already have, whose upkeep acts as a steady overhead expense and first charge out of our earnings. The National Industrial Conference Board, which is always busy gathering and compiling facts and figures concerning all current problems, has footed up the bill recently, and has discovered the astonishing fact that one-eighth of our national income now goes to pay taxes. Moreover, it finds that one out of every twelve individuals in this country, over sixteen years of age, is on the public payroll!

Here, surely, is food for thought and enough to make us pause in our impatient demands for more government activity, which means yet more taxes and yet more government employees whom we must feed, clothe, and send to the movies. Putting it in another and still more striking way, the Conference Board states that the government payroll (now including federal, state and local governments) amounts to 50 per cent of the wage bill of industry!

These facts must also be considered with respect to the proposed soldiers' bonus, which is being again determinedly pushed, and which would now be in operation had it not been for President Harding's veto. The United States Senate Finance Committee estimates that if the Bonus Bill becomes a law, nearly four billions of dollars will be added to the national debt. Commenting on this, the National Industrial Conference Board says: "There is a limit to the tax-paying capacity of the nation, and according to general business opinion that limit is rapidly being approached. It is pointed out that the burden of taxation imposed by state and local governments has in recent years been growing tremendously, and while federal taxation has declined somewhat, the expenditures of other tax-levying authorities, defrayed out of taxes and by bond issues, have been increasing phenomenally." "Students of economics and finance," says the report of the board, "are familiar with the inflationary forces which large public debts and increased taxation generate. This inflation would not only be reflected in increased price levels, but also would tend to depress the price of government bonds, and thus entail hardships to investors."

These reports reflect a condition which has been too striking during the last few years to escape observation. The average citizen is leaning on the government, and urging the government to make new expenditures and to hire new employees to further his pet schemes; and he will gladly agree to the government doing this for everybody else, if it will do it for him also. He forgets that he has in the long run to pay these bills. He forgets that inevitably his overhead plant, represented by the government organization, while necessary, is bound to be relatively inefficient, and to become more inefficient the larger it grows. The present adminstration in Washington is making a determined effort (reflected in part by President Harding's veto of the soldiers' bonus) to keep down the rising flood of expenditures. It is a task in which the public should earnestly co-operate, for its own prosperity.

The Gold Question

IT IS NOT DIFFICULT to judge where lies the heart of the new president of the American Mining Congress, Mr. H. W. Seaman. His extended address before the Milwaukee convention on the world's gold debts, reproduced in the issue of the *Journal-Press* of Oct. 6, was enough to indicate that he has given the gold problem much attention, which is natural, considering that he has been prominently engaged in gold mining in the Black Hills for many years.

Touching, as it does, our very existence and the welfare of nearly every civilized being on the face of the earth, the gold question is indeed a serious one. The cost of living, international commerce, reparations, Allied debts and other tremendously vital topics of today are concerned with it. Mr. Seaman's address presents once more the gold miners' difficulties and opens discussion anew of this interesting matter. The gist of his speech was a plea for a greater gold production to serve as a foundation for the enormous gold debts of the world, which, as every one knows, are mainly unsupported by any collateral, being only simple promises to pay.

We fear that the annual gold production of the world is only a drop in the bucket compared with the magnitude of the world's indebtedness. What is a mere $300,000,000 compared with, say, the debt of Germany to the Allies —also in gold—of some $40,000,000,000? If we assume, that by some extraordinary means Germany would be provided with the world's gold output to help discharge its obligation, it would take 133 years of gold mining, at the rate stated above, to furnish gold to pay that debt alone. The same reasoning can be made to apply to the discharge of the British debt to the United States, which would also require a long period of gold mining to give it a substantial gold basis.

It is not, of course, the case that the war loans of the United States were made by granting the Allied nations huge sums in gold. Instead of giving the Allies great quantities of gold, which the United States could not have done in any case, they were allowed large bank credits with which to purchase war material. It was goods—war supplies—and not gold, that was loaned and shipped abroad. If these debts are ultimately discharged a similar means will have to be used—that is, the United States will have to accept goods in payment.

In everyday commercial affairs where a transfer of

money is concerned gold has come to play a subordinate part to bank credit. Obligations in business are discharged by bank checks, drafts, and other commercial paper far more frequently than by an actual exchange of governmental currency units—metallic or paper. Moreover, the great majority of this bank paper is pure credit—loans—made by financial institutions. Well over 80 per cent of the business in the United States is transacted on credit. Behind the vast monetary machine stands a supply of gold ample for the existing system. Anyone can readily obtain all the precious metal he needs or is entitled to by exchanging government currency for it.

Not only does gold play a subordinate part in domestic commerce but also in foreign trade. Shipments of gold from one country to another are relatively small compared with the total volume of trade between those countries. It is only the excess balance of trade that is settled by a gold shipment. Despite its imperfections, we must admit that the whole system functioned efficiently before the war. Unfortunately, the device is delicate, and just when it is expected to show its greatest usefulness and stability, in a time of an emergency such as war, the system almost collapses through its abuse—countries inflate their currency to the point that the gold basis is almost entirely abandoned; and then in a panic they impose embargoes on the shipment of whatever reserves of gold they have to foreign countries to settle trade balances.

It is a lack of full consideration of these principles which may have prompted Mr. Seaman to state that "either we must bring up the world's stock of gold to a ratio that will satisfy the world's stock of promises to pay in gold or else we must reduce the stocks of promises to such an extent that the gold stock will suffice to pay them within the approved ratio. It is a question between redemption in full or redemption in part and repudiation of the balance." The issue is not so sharp as that.

Gold miners are victims of the inflationary policy that was pursued by the government in winning the war. They are victims of a monetary system that permits easy expansion of the currency without a corresponding expansion of production. They are victims of a fluctuating high price level. The gold-mining industry is not in so bad a condition now as it was in 1920, when the purchasing power of the dollar was lower by about 25 per cent, and inasmuch as conditions should become more normal the world over it is not too much to expect that the purchasing power of the dollar will gradually approach nearer to its pre-war rate.

Is not the gold-mining industry best served when, with hosts of fellow Americans, it lends its energies to the correction of high price levels, rather than to an attempt at obtaining a gold bonus? In one case it has the support of millions of people who, like the gold miners, are unjustly affected; in the other it is waging an uphill fight with slim prospects of success.

The trouble is that we are afraid to apply the cure. We do not believe in purchasing foreign goods in open competition with our own produts and therefor surround ourselves with an inordinately high tariff. We have an immigration policy that prevents us from getting a larger labor supply, in favor of which we will admit that much may be said. But owing to these and other reasons prices remain high and the gold-mining industry suffers.

Newspaper Science

THE UNCANNY INSTINCT of the daily newspapers for the inaccurate, when it comes to scientific and technical news, has long been a subject of wonderment to us. Some day we shall have explained to us the reporter's psychology which makes it a foregone conclusion that his mind will jump the track and immediately and infallibly arrive at a wrong and ridiculous conclusion when he starts out with a scientific fact.

The *New York Sun and Globe* contains, for example, a dispatch from Washington, as follows: "Fur coats will be unknown in the Klondike in another thousand years or so, according to observations of Dr. Charles D. Walcott, of the Smithsonian Institution, who reports that the heat from the earth's surface is gradually driving the glaciers of the northern country further toward the Arctic Circle and the Pole."

While this is ostensibly Dr. Walcott's conclusion, it actually is the reporter's. What Dr. Walcott actually imparted to the intelligent news hound is revealed in the last paragraph of the dispatch. "Dr. and Mrs. Walcott recently returned from an annual inspection of the famous Selkirk Glacier on the Canadian Pacific Railroad, and he says that during the seven years that he has observed it the huge ice block has moved backward 1,070 feet."

The alertness necessary to a mind that must engulf and transmit all the news seems to be compensated by a corresponding thinness of intellect. Certainly no more than a grade-school type of intelligence is necessary to know that the Selkirk Glacier is a local mountain glacier that covers a very small area; that as it retreats it will not gradually recede toward the Arctic Circle and the Pole, but toward its own little cirque in the mountains where it heads; to know that there are no regional or continental glaciers in the Canadian Rockies, the Klondike region or Alaska; and that the temperature of winters in the north will not be affected, or correspond in any noticeable way, with the shrinkage of any local glaciers. Such local glaciers—and there are many—as occupy valleys in the Alaskan mountains and other ranges of the west are not necessarily in the coldest regions. The glaciers of the Alaskan coast and the adjacent coast of British Columbia are there not because it is very cold, but because there is a great annual precipitation of rain in the low regions, of snow on the upper parts of the mountains. The region is one of relatively mild climate. Further north, where it is very much colder, it is also much drier; and there are few or no glaciers.

And if the sapient reporter did not know any of the above mentioned matters of common knowledge, he could at least have taken his pad and pencil, and figured that if the ice front retreated 1,070 feet in seven years, it would retreat about thirty miles in a thousand years, which would bring it substantially no nearer the remote Klondike region, or the Arctic Circle, or the Pole, than it is now.

The crime of it all is that newspaper skimmers—we all skim—will absorb the brilliant idea that the winter temperature of the Klondike region and Arctic America in general is rapidly rising, and this will perhaps pass into one of the general stock of misstatements which everybody quotes, such as the information that the Mexican is lazy and that the Turks should be run out of Europe.

Reopening a Bit of Silver History

AT A HEARING of the Commission of Gold and Silver Inquiry—the last one in Washington held before changing the center of activities to Reno—a subject of great moment to the silver-mining industry was investigated—namely, the transactions made by the United States Government to stabilize Far Eastern exchange in 1920. Owing partly to the complexity of the matter, and partly to an incomplete record, their significance has not been generally realized, but they mean just this much to silver miners: If the commission can show that these transactions came under the scope of the Pittman Act, and no other, over 30,000,000 oz. of silver remain to be purchased by the government, or an amount equivalent to the silver which was shipped abroad for exchange stabilization.

The reader will recall that in 1919-1920 silver reached remarkably high price levels—so high, in fact, that the silver coinage of the United States, as well as that of nearly every gold standard country, was threatened with the melting pot because the coins were in imminent danger of becoming worth more as bullion than as pieces with a fixed face value. This condition actually did happen for a short time in this country. To check this tendency, and to protect its silver currency, the United States Government undertook to ship record-breaking amounts of silver to the Orient so as to satisfy the seeming insatiable silver appetite of the Far East. Through the intermediary action of the Federal Reserve Board and several large commercial banks, 30,793,529 silver dollars were exported to Asia. Now the question arises, under what authority did the government act? Was it by any chance the Pittman Act? According to the testimony of Under Secretary Gilbert of the Treasury Department: "The transaction is clearly sustainable under the Trading With the Enemy Act," and "what was done had no relation to the act of Congress approved April 23, 1918, known as the Pittman Act."

This seems to us a highly debatable point. If the Trading With the Enemy Act, which was passed by Congress soon after the declaration of war in 1917, gave the Federal Reserve Board and the Treasury a mandate to engage in these Oriental silver transactions during and after the war was over, what was the occasion for ever passing such a law as the Pittman Act? Could not the same Trading With the Enemy Act have been invoked to ship the enormous quantities of silver to India as actually done under the Pittman Act? The shipments of silver to India kept the price down, and so did those to China.

The Trading With the Enemy Act is vague with regard to the power conveyed upon the President in the regulation of exchanges; the Pittman Act is explicit—it states in Section 3, "That sales of silver bullion under authority of this Act may be made for the purpose of conserving the existing stock of gold in the United States, of facilitating the settlement of trade balances adverse to the United States, of providing silver for subsidiary coinage and for commercial use, and of assisting foreign governments at war with the enemies of the United States." Furthermore, it is noticeable that in the 1920 Annual Report of the Secretary of the Treasury the silver operations of the government are given in great detail, in such a form as to lead one to believe that the Pittman Act was the ultimate authority for them. No mention is made of the Trading With the Enemy Act in describing the silver exchange transactions. Then again, was the Trading With the Enemy Act intended to cover silver transactions made two years after the armistice?

Doubtless the commission will not let the matter rest where it stands today. More light is urgently needed not only on the Far Eastern exchange transactions but also on the silver dollars additional transferred to the Federal Reserve Bank—55,000,000 of them.

The Secretary of the Interior

THE ACTION of Secretary Work in dismissing Director Arthur P. Davis, a veteran engineer, from the Reclamation Bureau, and appointing another Davis, a politician, in his place, may yet turn out to be unwise politics for the Secretary and his protégé. Secretary Work was a doctor in Colorado who was also in politics, and who accepted in the Harding administration the position of Second Assistant Postmaster General. The First Assistant Postmaster General having been killed in the theater disaster in Washington, Dr. Work became First Assistant Postmaster General, and when Postmaster General Hays went into the movies, Dr. Work became Postmaster General; and when Mr. Fall resigned as Secretary of the Interior, he succeeded him. By the queer turns of fate this inconspicuous and inexperienced man thus becomes in charge of some of the most important technical and engineering operations of the government, including all representation of the mining industry, the Reclamation Service, and other work.

The directorship of the Reclamation Service is under the Civil Service, and Director Davis could not normally have been removed without the Secretary showing cause. To get his friend in, he resorted to a diplomatic coup. He had authority to abolish a position entirely; so he did away with the position of Director of the Reclamation Service, and with it the Director: then he appointed his friend as Commissioner. Even at that, the Civil Service Commission ruled that he could not do this, after the thing was done; so he had to obtain an order from the President confirming his arrangement. This order was sent to President Coolidge and approved; and apparently the Secretary and his Commissioner were still sitting firm. The Washington papers, however, on inquiry were recently told by the President's office that the President had no recollection of the matter, and that if such an order were signed it was as a matter of routine. Secretary Work in the meantime has appointed an outside commission to investigate and report concerning the reclamation work. It will be wondered at by some why he did not investigate before discharging Mr. Davis; but such is the way of great men. This commission consists of men who are not engineers. Ex-Governor Thomas Campbell of Arizona is on the commission, and is represented as the engineer member. However, although he has had something to do with mining, he is not an engineer.

The Federated American Engineering Societies, it is reported, will make a strong protest concerning the removal of Director Davis and the policy which it displays of the replacement of engineers in the public service by politicians. Will President Coolidge stand for such retroactive practices, when he is once acquainted with the facts; or is he too busy a man to handle these matters? It is to be hoped in any event, that the tenure of the office of Secretary of the Interior by Dr. Work will be mercifully a short one.

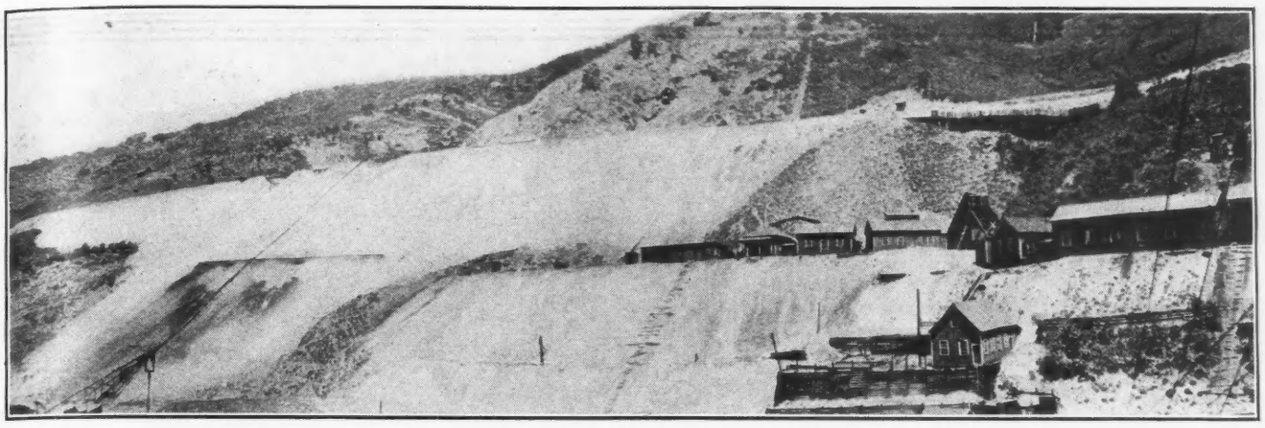
A Prominent Canadian Mining Geologist

WILLET G. MILLER

POSSIBLY no Canadian connected with the mining industry is so well known on both sides of the border as Dr. Willet G. Miller. He is a regular attendant at the annual meetings of both the A.I.M.E. and the Canadian I.M.M., a wide traveler, and a man whose large stature and distinguished presence prevent his ever being lost in the crowd, even though he should remain silent. Dr. Miller may possibly not be quite so well known to those living on the Coast, for he has made his headquarters in Ontario since he was born there in—well the date of his birth seems to be shrouded in mystery, but a clew may be found in the fact that he was graduated from the University of Toronto in 1890. While there he specialized in chemistry and also took several courses in geology and mineralogy, work which he followed for the three years after his graduation, he having been granted a fellowship. This required some teaching, and further experience in his chosen field was secured during the summers with the Canadian Geological Survey, under Dr. Robert Bell. At the expiration of the fellowship at Toronto he became a teacher of geology at the School of Mines of Queen's University, at Kingston, remaining there for nine years. During this time he took post-graduate work at Chicago, Harvard, and Heidelberg, so that his education has been unusually complete and varied. Both Toronto and Queens have granted him the LL.D. degree. Since 1902, Dr. Miller has had only one real official position—that of Provincial Geologist of Ontario—but he has had numerous jobs. One of the first exciting things in his duties as Provincial Geologist occurred in 1903. In that year the railroad was being built north of North Bay, on Lake Nipissing, to tap the virgin forests and rich agricultural lands of the clay belt of northern Ontario. One of the railroad men brought to Dr. Miller a sample of niccolite, which so interested him that he determined to make a quick trip north before the ground should be covered with snow. A French Canadian blacksmith who had worked in phosphate mines had made the discovery, but as there were no mining men in the railroad party no one got very excited about it. This blacksmith's name was La Rose—hence the La Rose mine, which has since produced over 25,000,000 oz. of silver. Other discoveries were rapidly made, and development of the Cobalt district by mining men soon began, though the public refused to take much interest in the discoveries for a year and a half, having been badly treated in a mining boom a short time before. Dr. Miller made the first report on the district and was the leader in tracing the geology of the deposits and interesting prospectors in that region, and latterly in those to the north, where such successful development has taken place, Porcupine and Kirkland Lake being of outstanding importance. Other interesting work to which Dr. Miller has devoted a special amount of attention has been a study of the corundum belt of eastern Ontario, and a thorough study of the nickel industry of the world, which was made during the World War. Along with Messrs. George T. Holloway, McGregor Young, and T. W. Gibson, he was appointed a member of the Royal Ontario Nickel Commission, whose report is one of the most comprehensive monographs of its kind ever published. This work necessitated wide travel to the various nickel districts of the world, though the Sudbury district is by far the most important. The pre-Cambrian rocks are the great metal-bearing formations of Ontario, and it is to these that Dr. Miller has devoted most of his life work.

WILLET G. MILLER

Dr. Miller is a member of several clubs in Toronto and of the more important technical societies. He was made an honorary member of the Institution of Mining and Metallurgy in 1908 and its gold medalist in 1914. Since 1918 he has spent some time in London, as he had previously, as Canada's representative in the Imperial Mineral Resources Bureau. While there in 1922 he took the opportunity to visit South Africa especially to study the geological and mining conditions on the Rand. He also visited certain of the larger diamond mines and went north as far as Northern Rhodesia. He is a past president of the Canadian Institute. Canoeing and exploration are recreation to him as well as work, and despite the rigors that such trips impose he still enjoys them.



The surface plant of the Ohio Copper Co.

The pump house and pipe line are on the left. Solution is discharged at the top of the embankment in a perforated launder. Headframe of inclined shaft to Mascotte tunnel is shown on right.

Leaching a Copper Mine

The Ohio Copper Co. Initiates a New Mining Method and Becomes an Exceptionally Low-cost Producer

By Felix Edgar Wormser
Assistant Editor

LET A MAN SUGGEST anything new, untried, or revolutionary, and he will generally promptly be scoffed, criticised, and often ridiculed for his ideas. Samuel K. Kellock and Fred E. Turner, manager and superintendent, respectively, of the Ohio Copper Co., at Bingham, Utah, know that this is so, for they have successfully introduced into mining practice something which a few observers proclaimed visionary—the leaching of caved ore in place.[1] They were informed for one thing, when the subject was first broached, that the solutions would not percolate evenly throughout the orebody but would "channel" through it. They were also told that the action of the solutions would have a tendency to clog the caved area by the formation of talcose substances and would prevent the dissolution of further copper mineral. But none of these dolorous predictions has come to pass. At present the Ohio Copper Co. is producing copper by this unique method at a cost between 6½ and 7½c. per lb., against a cost a few years ago which caused the company to shut down tightly with but small hope of working the property profitably by ordinary methods of mining and milling in a normal copper market.

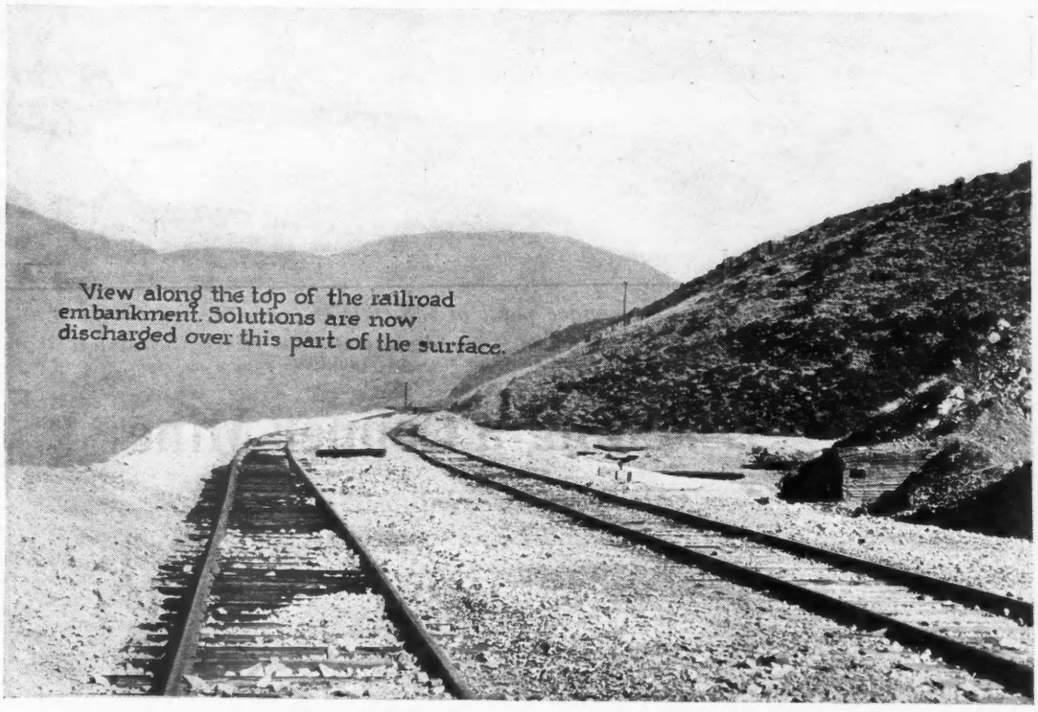
The most pleasing part of the story to the stockholders and directors of the company must be the fact that the experimental work and the installation of equipment necessary to insure continuous production by leaching was done without recourse to an appeal for funds. Mr. Kellock felt that by selling a few of the ore-dressing machines in the company's large and idle mill at Lark sufficient money could be raised to purchase the pumping equipment and apparatus needed to give the leaching scheme a thorough trial. He was authorized to do so, and with the $15,000 received from the sales bought a moderate-sized pumping plant and minor accessories. The work has been more than self-sustaining ever since.

The Ohio Copper Co. had never been successful in its attempt to work on large-scale regulation methods. The mill at Lark, a few miles away from the mine, failed to come up to expectations after it was built and operated, owing to the difficulties involved in treating the oxidized ores which are such an important part of the Ohio orebody. Extraction was low and costly, and it has been estimated that an 18c. copper market is required before the mill can make a profit. The very impediment of successful milling, however, is an advantage when it comes to leaching, as the oxides are readily soluble in the ordinary water used. Over 300,000 lb. of cement copper is being produced per month, an output that will be probably trebled by the present installation of larger pumping equipment.

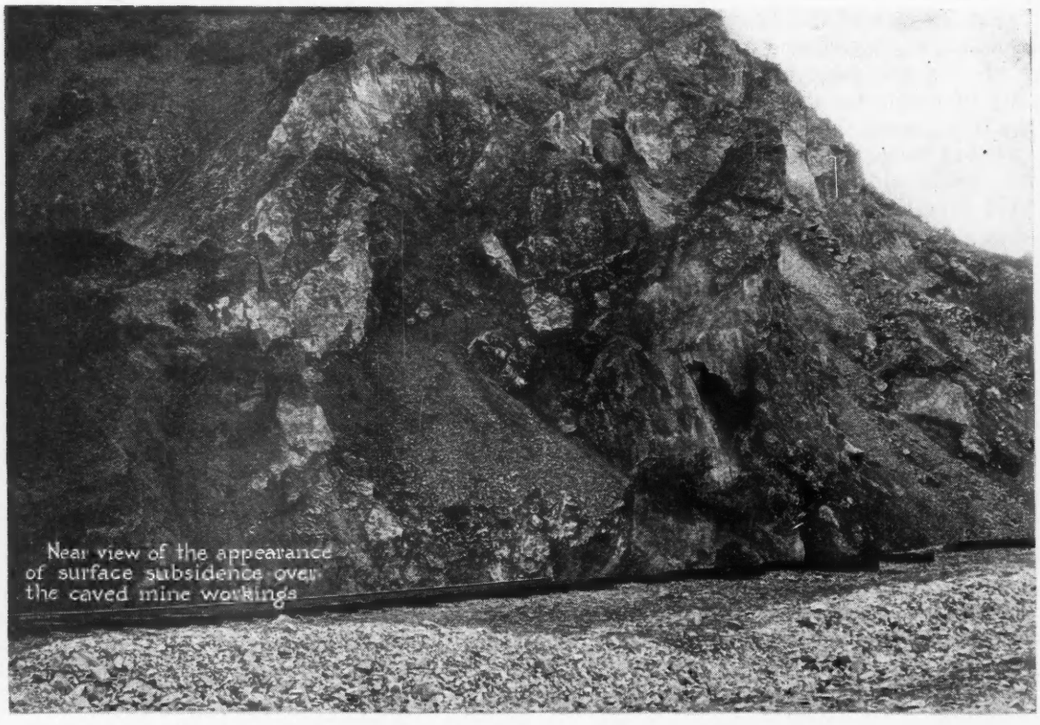
The mine itself is on the east side of Bingham Canyon, directly opposite the huge open-pit Utah Copper operations. The surface plant is extremely unpretentious, as can be seen by an inspection of the accompanying photographs. The caved mine area is about 800 ft. long, 900 ft. wide, and 900 ft. deep along the dip. It was formerly worked through an inclined shaft dipping 50 deg. E., 1,400 ft. deep, sunk in the footwall, and connected at the bottom with the main haulage or Mascotte tunnel, through which the ore was trammed by electric motor about 2½ miles to the mill at Lark, on the other side of the Oquirrh range. The shaft has two compartments and is used to handle men and supplies.

Mining engineers will recall that the Ohio Copper mine in its "mining" days was famous for the unusually low cost of mining with the block-caving system used. The ore was low in grade, carrying about 0.8 per cent copper per ton, so that some cheap large-scale mining method had to be employed. Blocks 100x100 ft.

[1]Messrs. Varley and Oldright have also described this operation in a paper delivered before the Utah Metal Mining Institute at Salt Lake City, May 5, 1923, entitled "Leaching of Caved Areas of the Ohio Copper Mine."

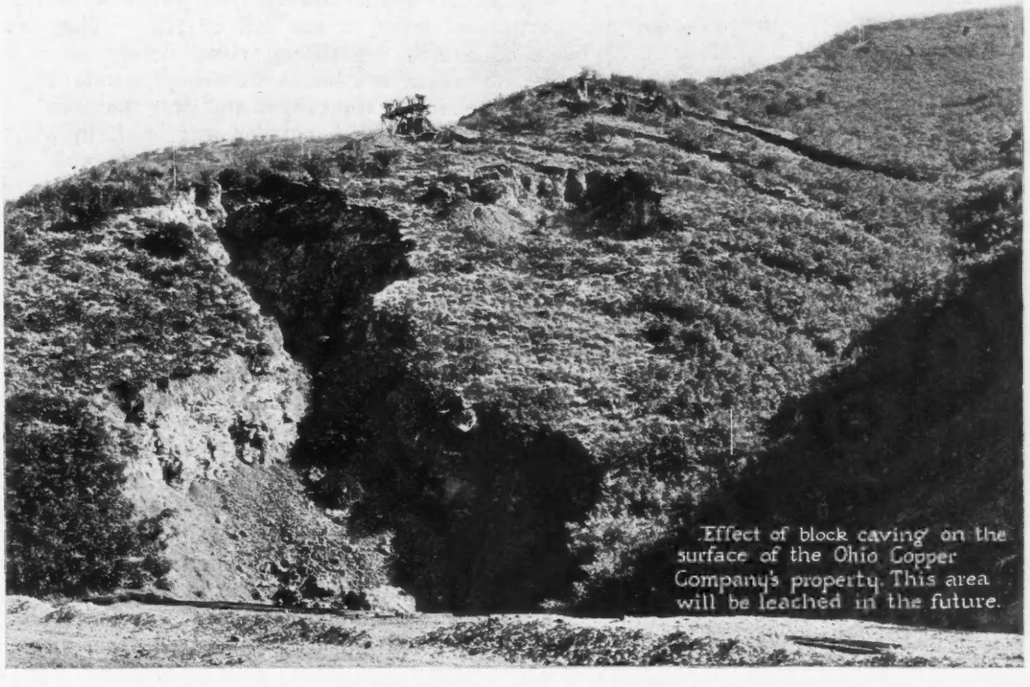


View along the top of the railroad embankment. Solutions are now discharged over this part of the surface.



Near view of the appearance of surface subsidence over the caved mine workings

The first pumping plant installed, with a wooden pipe line leading to a launder. The pipe line rests upon fill serving as a railroad embankment over the caved mine.



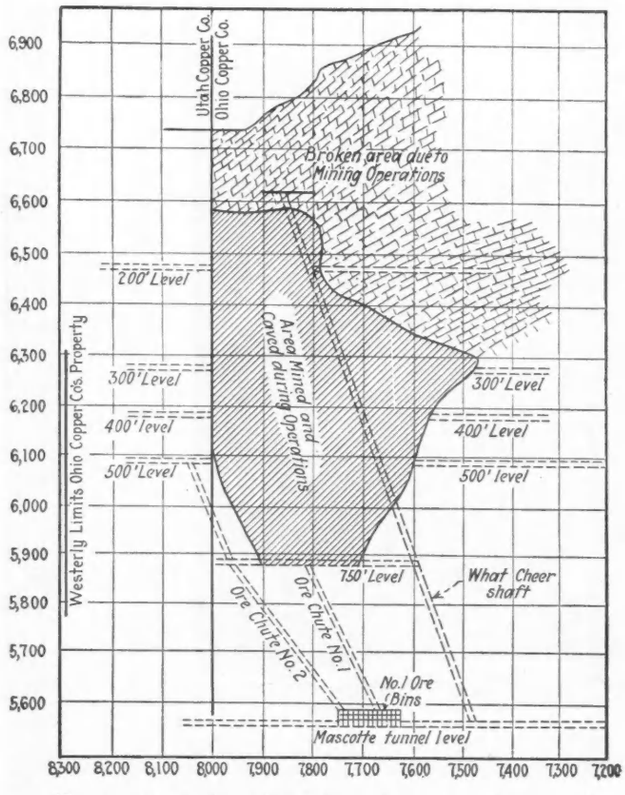
Effect of block caving on the surface of the Ohio Copper Company's property. This area will be leached in the future.

square and 60 ft. high were caved, and although the preliminary work generally consumed several months, mining of these blocks cost only about 22c. per ton before the war. The underground work naturally had its effect upon the surface, which subsided and caved, giving it the appearance shown in accompanying plates. The broken ore in the caved areas was drawn through raises to ore bins on the Mascotte tunnel level and hauled to the mill. These raises are excellent passageways for the solutions which now leach the caved mine workings.

Oxidation of Sulphides to Sulphates

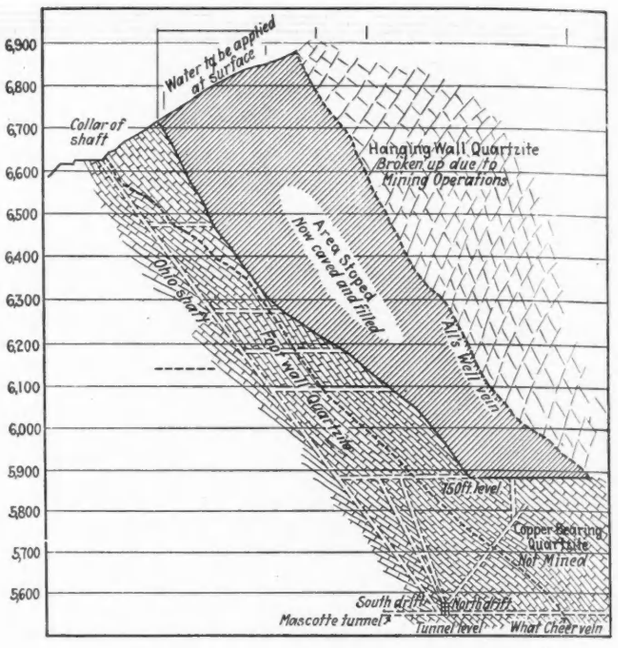
The orebody is a mineralized quartzite and quartz monzonite carrying oxidized copper minerals, chalcocite, and pyrite. The monzonite is considered to have intruded a bed of sandstones, altering them to quartzite. The richest parts of the deposit are found along the contact of the quartzite and monzonite. Both hanging wall and footwall are in quartzite, which is practically impervious to the solutions used and is ideally suited to prevent loss of solution through dissipation in the walls. The hanging wall is shattered from the caving that took place, whereas the footwall is unbroken. Caved sections are now difficult of access, but those mine workings which can be reached from the main shaft show strikingly the effect of oxidation on the copper minerals in the ore.

Surfaces of drifts and crosscuts in the orebody a few hundred feet from the shaft are covered with a fine lattice work of pale blue and green veinlets of oxidized copper ore. The air in these drifts is warm but not uncomfortably so. It readily circulates in the caved areas, rising from the tunnel level below to the surface and facilitating oxidation. If the surface appearance



East and west geological section—looking north

Precipitation boxes extend east along the Mascotte tunnel. Most of the solution reaches them through raises No. 1 and No. 2



North and south geological section

Note the raises from Mascotte tunnel leading to caved stopes.

of these drifts is any indication of the condition of the caved stopes, they must be in an admirable condition for leaching. Oxidation of the ore is also aided by the presence of pyrite, which probably accounts for most of the heat in the drifts.

The copper content of the ore is widely variable. The management estimate that reserves are about 38,000,000 tons of 0.3 per cent ore.

It was with considerable trepidation and interest that Kellock and Turner watched the progress of their experimental work in the fall of 1922. They first installed a 4-in. centrifugal pump driven by a 60 hp. electric motor, and laid a wooden pipe extending from it up the side of the canyon and over the caved surface for 150 ft., where a launder was built, in which the pipe line could discharge about 300 to 400 gal. per minute. Page 667 gives a view of the original installation and shows the pipe line extending halfway up the hill which covers a goodly part of the caved surface of the property. The dark, stained appearance of the surface is due to the discoloring and oxidizing matter in the water used for leaching purposes and shows the exact location of the original points of application.

In the meantime preparation was made to catch any solution which might percolate through the mine in a series of precipitation boxes filled with old iron junk. As only a few raises extended from the main haulage level to the caved stopes, it was felt that the enriched solution would have to emerge at these raises, and the boxes were therefore placed close to them. After the stage had been well set, common ditch water was pumped from Bingham Canyon at the rate of 300 gal. per minute to the launder, where it was distributed over the surface and quickly disappeared from view. The water was a rusty, cloudy brown, coming mainly from mine workings farther up the canyon. It contained no acid, and no outside reagent was added to it.

The effect of the experiment was anxiously watched, and it was only after about forty-eight hours of intermittent observation at the raises on the Mascotte tunnel

level that the vigil was rewarded. At that time a stream of slightly clouded water began to issue from the raise, but it changed to a clear, deep, coppery blue after a short time. This was most encouraging, and steps were immediately taken to enlarge the precipitating plant and the scope of the experimentation. It was necessary to widen the Mascotte tunnel to make room for the precipitation boxes along each wall and leave space for a haulageway in between. By placing the boxes in the tunnel near the bottom of the shaft a working place is provided that is cool in summer and warm in winter, giving a more uniform temperature than could be obtained with an outdoor installation.

The boxes were built in ten sections of 320 ft. each. They are made of 2-in. planks 32½x32½-in. in cross-section by 16 ft. long, and are placed end for end in the tunnel in two rows along the walls. By-passes are furnished to permit the solution to be transferred from one row of boxes to that opposite, to facilitate dressing or repairing any particular section. Each box has a false bottom, consisting of a light, sturdy lattice-work which is nothing more than a series of ½-in. strips ¼ in. apart, on top of which another series of strips is placed at right angles ⅜ in. apart. This false bottom rests upon cleats 16 in. above the bottom of the box. Trouble was experienced for a time with leakage of solution from the precipitation boxes. This was remedied by "guniting" the interiors, which checked the leakage and increased production.

Loosely baled detinned scrap from Pacific Coast plants is used as a precipitating medium. It costs $20 per ton delivered, and although more expensive than the iron junk which might otherwise be used, is far more satisfactory, being easier to handle and more uniform in size and composition. It has been found that the first four sections of the precipitating plant make 50 per cent of the cement copper and that about 1 lb. of scrap is required for every pound of copper produced. The solution carries about 4.6 lb. of copper per ton, of which from 90 to 97 per cent is precipitated.

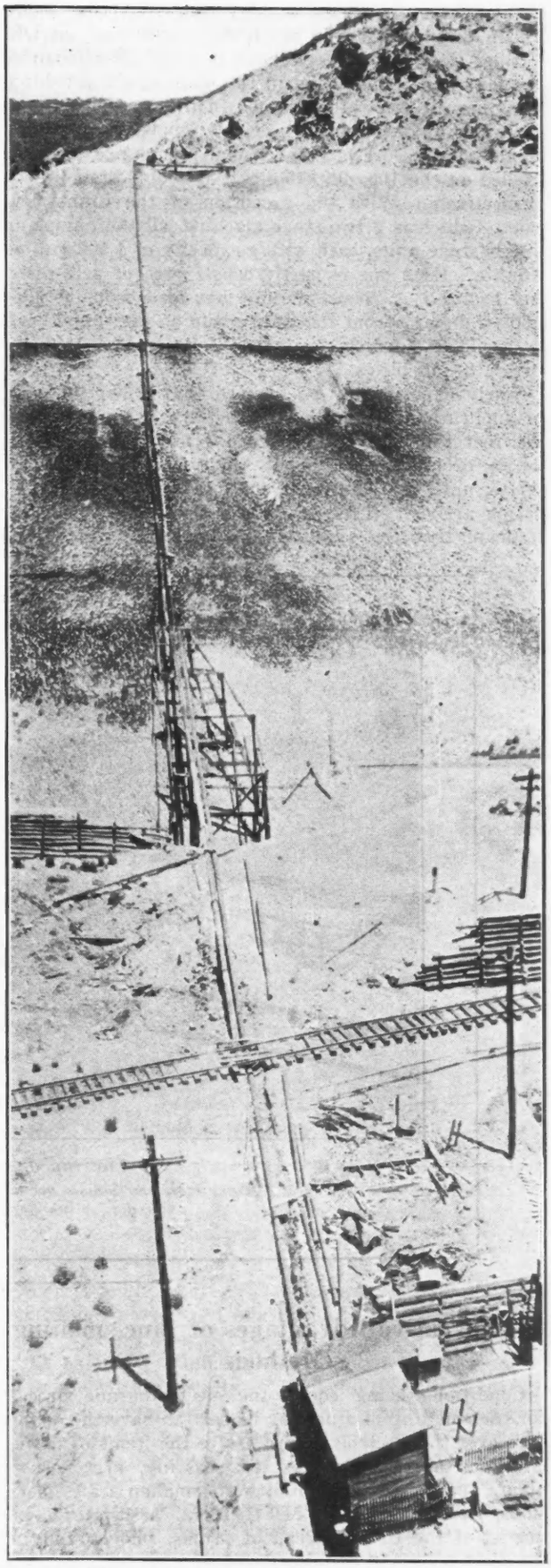
The high-grade cement copper produced assays between 90 and 94 per cent copper. Boxes were formerly dressed twice a week, but will be dressed every day when the new pumping plant is completed and operating. The copper is shoveled into mine cars and shipped to Garfield for smelting. The chief and only difficulty in precipitation is the tendency for the copper to adhere to the scrap. Efforts are being made to correct this trouble, which may arise from a number of causes, such as the presence of impurities, acid, or organic matter. In the initial stages of the work the water from the last boxes was allowed to go to waste, but owing to the dearth of adequate water supplies, it is planned to recirculate this solution, together with other water drained from the mine, and to leach with it again.

To present data as to the cost of operations, the following average financial results for the first five months of the year 1923 are given:

	Cents Per Pound
Operating cost, office expenses and supplies, etc..	4.341
Smelting and selling	2.943
Total	7.284
Received for copper	15.33

The operating profit up to July since the beginning of leaching operations is close to $100,000.

To increase production, which had been running around 300,000 lb. per month, it was decided to increase the volume of solution used for leaching to over three times its earlier quantity, or from a rate of 400 to a



The original pump house and pipe line

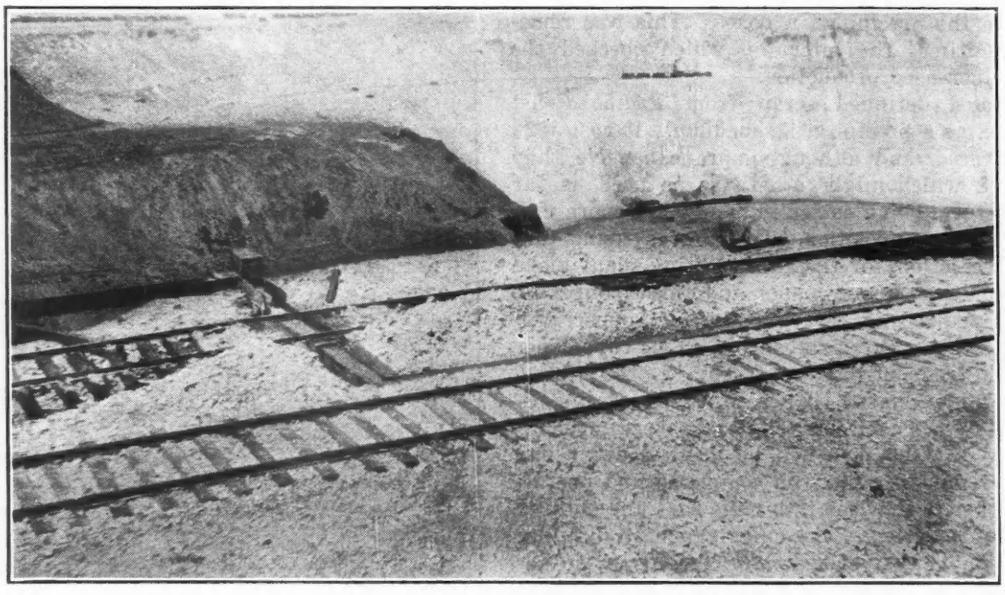
Another unit has been erected in the Ohio shaft. Note the stained surface areas. They mark the places over which the solution was first allowed to percolate from the first launder used.

rate of 1,500 gal. per minute. Water is none too plentiful in Bingham Canyon or on the property of the Ohio Copper Co. All of it available is carefully husbanded. A plant has been erected in the main shaft, capable of pumping all the water drained in the Mascotte tunnel, including that from the precipitation boxes, by stages to the surface. Four centrifugal pumps are being installed on the 100, 400, 750, and Mascotte tunnel levels, respectively. With the exception of the tunnel level pump, which is a two-stage machine, all the pumps are single-stage units, each with a capacity of 1,500 gal. per minute. Each one is partly constructed of acid-resisting bronze. A "booster" unit has also been installed, 500 ft. distant from the main pump on the tunnel level, to assist in furnishing it with solution from the last precipitation boxes.

Early experimentation showed that when the point of application of solution to caved area was moved only six feet the volume discharged into the precipitation boxes decreased for about thirty-six to forty-eight hours, until the solution from the new point of application arrived. Then it increased again. This would indicate that the tendency to "channel," which some critics thought would be a possible objection to the method, is not a source of trouble.

To date only a fraction of the mine has been treated. The accompanying photographs show the stained sections where the solution has been allowed to percolate over the surface and give an idea of the ground that remains to be treated. Careful computation of the surface of the caved area shows that it contains approximately 840,000 sq.ft. In the operations of the company up to July 31 about 1,000 sq.ft. of this surface had been covered, which leaves a large area still untreated.

The results that have been achieved were accomplished entirely with the poor quality of water available in Bingham Canyon. Some day, perhaps, acid will be added to increase dissolution, but no expense for chemicals has yet been found necessary. The present procedure is to treat a certain area of the mine, and then to abandon that portion temporarily while another section is being treated. This is done for the purpose of permitting further oxidation in the leached area. After which it is planned to return to the first section and re-leach it. The treatment of original ore in place will also receive attention at some future time.



The top of the embankment

Water from the canyon below is discharging into the distribution launder. Utah Copper mine in background.

Comparative Advantages of Zinc-smelting Methods

Conditions being equal, the electrothermic process for the smelting of zinc may be said to have the advantage over the electrolytic process in the items of power, labor, metal recovery, cost of roasting, first cost of plant, and in its adaptability to smaller scale operations, according to B. M. O'Harra, associate metallurgist of the U. S. Bureau of Mines, who is studying the electrothermic metallurgy of zinc under a co-operative agreement between the Bureau and the Missouri School of Mines and Metallurgy. The electrothermic process is superior to the retort process in the items of reduction, fuel, labor, metal recovery, ability to treat low-grade and impure ores, cost of roasting, first cost of plant construction and the cost of retorts and condensers.

The electrothermic smelter must be near cheap power, as must also the electrolytic, but as many retort smelters are now some distance from their supply of ore this is no great difficulty. Each of the three processes —retort, electrolytic, and electrothermic—has its particular field and there are undoubtedly places in this country where the electrothermic process could be profitably applied.

The Pre-Cambrian Veins of Kirkland Lake, Ontario

By J. E. Spurr

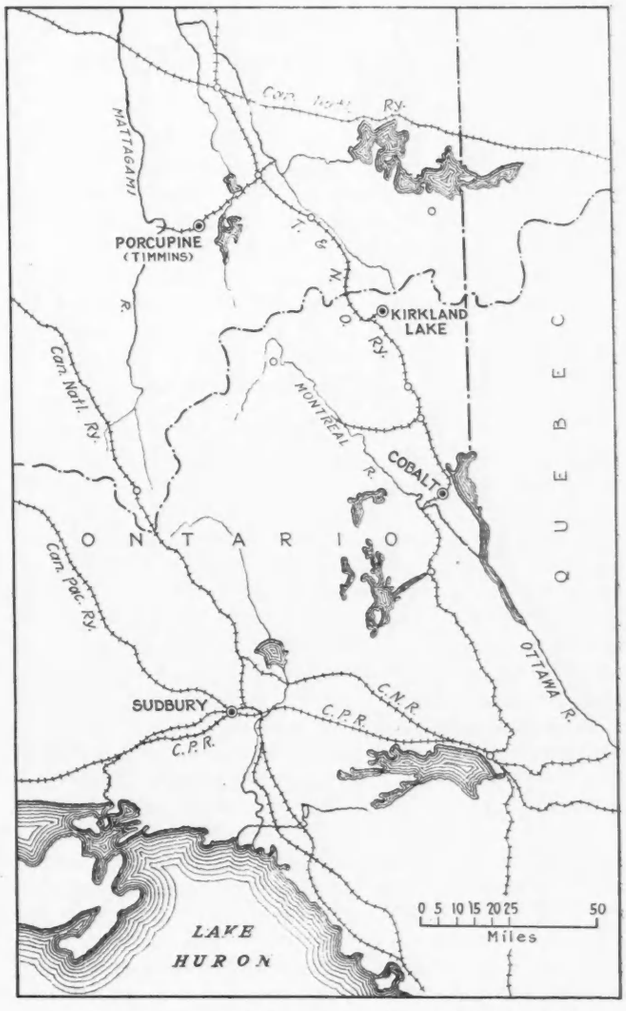
MOST OF THE MINES at Kirkland Lake are situated on a straight persistent zone of sheeting which has been worked on for two miles or more, and which is a zone of some fault movement—certainly subsequent to ore deposition and probably also previous to it. There are also some parallel zones and some minor branching ones. As pointed out by Percy E. Hopkins,[1] in the Kirkland Lake district there are intrusions of various alkaline igneous rocks, such as syenite and syenite porphyry, into older rocks, including Temiskaming conglomerate, sandstones and arkoses, which are highly tilted and folded. The intrusions are believed by the geologists of the Ontario Department of Mines to be differentiates from a common deep-seated magma, and to be of Algoman age, like the intrusive porphyry at Porcupine. As at Porcupine also, the gold is believed to have been derived from the same magma.

Briefly visiting three mines of the district—the Lake Shore, the Wright-Hargreaves, and the Tough-Oakes—I was able to observe some of the sequence of vein formation. After the initial shear-zone was developed—with probably not very heavy faulting—there was a first scanty injection of white crystalline quartz with scanty sulphides. This was a veindike intrusion, as seen at various points, especially in a vein exposed on the surface at the Tough-Oakes, which is about one foot wide between porphyry walls, contains sharp angular floating isolated fragments of the porphyry country rock, and carries $10 to $12 gold. This is probably, according to my information, the same vein as that photographed underground and shown in Vol. XXIX, Ontario Department of Mines, Part IV, page 39, which photograph shows (not too clearly) the characteristics of the vein. This white quartz stage is present in the main vein zone (which is locally called a "break") but is unimportant quantitatively and economically. The shear-zone varies in width from say one to thirty feet.

The second injection which I noted along the lode zone was a dark quartz, which carries much more gold than the initial white quartz, running up locally to hundreds of dollars per ton in value. This dark quartz cuts and includes the earlier white quartz, and also has replaced the sheeted porphyry to some extent, and irregularly, forming oreshoots of varying dimensions. This second injection was not marked by copious quartz, so was a relatively concentrated though siliceous metallic magma; and the replacement which it effected shows it to have been more gaseous (including in this term aqueousness or the presence of water-gas) and penetrant than the first quartz. Subsequently there was a third episode of mineralization—the deposition of free gold and tellurides in fracture and slip planes in the earlier quartz veins and in the sheeted and slickensided adjacent country rock. Since all the ore deposition, there has been some movement along the shear-zone, producing a little strike-faulting and accounting for a few of the barren and narrow stretches of the zone. Transverse dikes of olivene diabase cut the ore, and so are later than all ore deposition, as they are at Porcupine. Transverse faults also offset the veins moderately. Some of the faulting appears to be later than the diabase.

[1]30th Ann. Rep., Ont. Dept. of Mines, Pt. II, 1921, p. 23.

The bulk of the resultant lode material is altogether of the replacement type. The ore solution or ore magma was evidently relatively highly metallic and was suddenly injected, but was sufficiently attenuated by aqueous and other gases to replace porphyry in preference to actively intruding it in veindike form. Yet the presence of the early quartz veindike stage shows that we really have here in Kirkland Lake the same sequence of lode history as in other deep-seated gold-quartz districts, but with the different factors present in different proportions—from that at Porcupine for example. We have



Map showing location and relative position of the Sudbury, Cobalt, Kirkland Lake, and Porcupine districts

the more mobile, richer, quantitatively scanty, later-crystallizing portion of the typical gold-quartz ore magma well represented, but with very little of the slightly earlier-crystallizing white quartz veindike factor. The "ribbon structure" (the filling of fractures in white quartz veindikes by richer residual ore-magma derived from a deeper portion of the crystallizing veindike) at Porcupine shows that the richer residual fraction of the quartz ore-magma ascends upward; therefore at Kirkland Lake we may assume it to have been derived from crystallizing quartz ore-magma below, and from its relative quantity assume that the injected ore-magma veindikes were more important and bulky at this greater depth than is indicated by the scanty development of the quartz veindike stage at the horizons actually exposed

by mining. We may infer, indeed, that the Kirkland Lake ore deposits lie above the bulkier gold-quartz veindikes of intrusive origin, such as are typical of this zone at Porcupine and elsewhere. And if this reasoning is correct, the prospects for ore in depth at Kirkland Lake should be good—an opposite conclusion to the impression naturally made by the relative lack of quartz in the ore and the consequent lack of clear definition and apparent strength of the vein.

Besides quartz, in the lode materials, there is a little calcite and some barite; and the scanty metallic minerals include, of course, pyrite, with relatively rare galena and blende, and chalcopyrite.

Besides native gold, the Kirkland Lake district is distinguished by small quantities of various tellurides of gold, silver, and lead, (calaverite, hessite, and altaite), with rarely other tellurides. The presence of these tellurides corroborates, so far as it goes, the especially mobile and ascensive (gaseous) nature of the residual fraction of the ore magma, which brought up the gold from a lower crystallizing horizon.[2]

[2]The Ore Magmas, Vol. II, p. 617.

The Status of Nevada Mining

Editorial Résumé

ON MAY 29, 1923, purchases of silver under the Pittman Act were discontinued, since when the price has been about 63½c. per oz. Dollar silver had prevailed under the Pittman Act since May, 1920. Previous to that and beginning in May, 1918, silver producers had received approximately a dollar or more per ounce for their silver. Thus, for an interval of five years, silver producers have conducted their operations under favorable price conditions. They are now confronted with a cut of 36 per cent in income.

Silver Production Far Below 1913 Figures

Nevada produced 16,090,083 oz. of silver in 1913. Since that year silver production decreased to 6,863,580 oz. in 1919. In 1922, it reached 8,619,587 oz. On the basis of 7,000,000 oz., the gross income of the Nevada miners from silver will be reduced by $2,524,830. Needless to say, this new status has affected Nevada mining. During the five-year interval of high silver prices, wages increased as well as the cost of supplies and machinery. Silver averaged about 60c. in 1913; on the basis of commodity prices 63c. silver now has a purchasing power of about 42c., compared to its purchasing power of 60c. in 1913. To obtain a gross income of $7,000,000 per year, Nevada silver miners would have to produce about 11,000,000 oz. of silver, or an increase of 57 per cent on the basis of 7,000,000 oz. annual production. In 1918, Nevada produced 10,000,599 oz. of silver. Since then the silver production declined, but was accelerated in 1922 and early in 1923 through the influence of the Pittman Act. It is highly improbable that an annual production of 11,000,000 oz. will be made.

In 1921 the tonnage of siliceous silver ore mined by 133 producers was 543,345; siliceous gold ores to the amount of 63,850 tons was mined by 122 producers, and 60,365 tons of gold and silver ore was mined by 21 producers, in the same year. The bulk of precious-metal ore therefore comes from the silver mines. The siliceous silver ores averaged $2.42 in gold and 11.34 oz. of silver per ton. The comparative values at $1 and 63c. per oz. silver are $13.76 and $9.56 respectively; the difference in value is $4.20 per ton. As an example, the Tonopah Belmont Development Co. in 1921 recovered $14.07 per ton at a cost of $9.86 per ton and an operating margin of $4.21 per ton. Thus the present price of silver would have absorbed the operating margin.

The only new mine of note is the Betty O'Neil, south of Battle Mountain. This mine has high-grade ore in quantity. Its output will about compensate for the diminished production of Tonopah. The United Comstock, at Gold Hill, is in an uncertain position, but will probably contribute substantially to the silver production. The Comstock Merger mines may reach an operating stage within a year or more, but this at present is uncertain. More than likely Nevada silver production will be sustained around 7,000,000 oz. per annum.

At Tonopah the apparent bottom of the silver-bearing veins in many of the properties of this district was reached several years ago and since then exploration has been confined to the upper horizon, with successful results. Some of the properties have exhausted their possibilities and will probably permanently suspend operations within the next year. The Tonopah Development Co. has suspended its milling operations, but is still doing some exploratory work. The West End mill is operating at full capacity on ore from the West End and Halifax mines. The Tonopah Mining Co. of Nevada is operating its Desert mill at a small operating profit on custom and leasers' ore. Tonopah Extension is milling 11,000 tons per month and expects to increase this within the next year, provided a sufficient number of good miners can be obtained.

Employees Operating Rochester Corporation Property

The Rochester district is struggling along. The Rochester Silver Corporation has leased its property to its former employees, who appear to be keeping their heads above water. The Nevada Packard has succeeded in liquidating its indebtedness and is to be reorganized. Candelaria and Cortez are doing as well as can be expected. The Eureka district has possibilities, but is not contributing any material tonnage. Prospecting in the smaller districts continues without much change.

Mining in the gold-producing districts will continue about as usual. Copper mining in the Ely district has greatly improved, and Nevada Consolidated is producing around 5,000,000 lb. per month. The Consolidated Coppermines Co. is developing and making a fair production. The Walker copper district is dormant. Efforts are being made to secure a readjustment of ore freight rates in favor of the Thompson smelter. If these are successful miners and leasers will have a local outlet for their ores that will help considerably. Lead-silver mines are in a good position, and even some zinc is finding a market.

On the whole, the drop in silver prices has pressed hardest upon the silver miners by diminishing reserves and forcing upon them a greater degree of selection and consequent curtailment of tonnage. Less labor unrest and higher efficiency are the important factors that will improve the situation for the silver miners. This does not appear to be immediately attainable. However, increased production of copper and the improvement or maintenance of the present lead, gold, and zinc production will maintain Nevada mining at or about the position it held in 1922.

Possibilities of Centrifugal Force in Ore Dressing*

Clarifiers, Dewaterers, Amalgamators and Concentrators Based on This Principle May Be Developed for Use in Mills

By Oliver C. Ralston
Superintendent Pacific Experiment Station, Berkeley, Calif.

DURING last spring the U. S. Bureau of Mines made known that it was looking into possible uses of centrifugal force in ore dressing, with the object of determining whether the field merited study. Although it is still too early to state whether successful machines exist for the various fields in which centrifugal force might be applied, it is possible, as a result of much correspondence, to outline some of the fields that are under study and the possibilities of the use of centrifugal force in ore treatment. Therefore this paper will take the form of a brief discussion of the need of centrifugal force in ore dressing, and six distinct uses are considered.

Centrifugal clarification of water, or liquids containing finely divided solids which cause turbidity, is a field in which considerable work has been done, and machines exist for clarification of liquids, in which centrifugal force of greater magnitude than that found in any other commercial operation is used (so-called supercentrifugals). In ore dressing, the occasion for clarification of turbid waters arises from a variety of sources. Overflow water from thickeners or settlers, if discharged into streams, is occasionally objectionable to others. As a rule, the solid material is of little value, and the principal reason for removing it from the water is to avoid damage, an eventuality which has been of only minor importance in the United States but has occasionally been of great importance in Europe. Suspended minerals of copper, lead, or zinc have frequently been blamed for numerous kinds of damage. Although a centrifugal clarifier can be used for this kind of water, it has usually been found possible to build tailing dams of sufficient size to remove practically all of the turbidity by sedimentation; where the turbidity was persistent, flocculation of the solid particles has been brought about by the addition of lime or alum. Conditions may exist where settlers and flocculating agents could not be used, but these conditions are rare, and the large power consumption incident to the use of a centrifugal clarifier makes its use uneconomical. Where the turbid overflow comes from a concentrate bin or thickener, and the suspended solids are valuable, it is possible that centrifugal clarifiers can find a field. The question requires more careful study.

Centrifugal thickeners have been suggested. Such machines would occupy little floor space, and occasions are found where their installation high up in a building will save passing a stream of pulp down a considerable distance to a thickener and then pumping it back up. A centrifugal thickener would have to be capable of continuous feed and discharge of thickened product and clear water, and it is conceivable that the centrifugal force causing the separation could also be used for pumping the separated products to a higher level. Ordinarily, thickeners of the standard types operate with such a low power consumption, and are such relatively inexpensive machines to install, that new mills will always be designed to take advantage of these characteristics, so that centrifugal thickeners would find a possible use only in older mills.

The centrifugal dewatering of thickened material presents a more promising field for the use of this force. Frequently, thickened material must be filtered at a prohibitive cost, owing to the mechanical characteristics of the solids. The "neck of the bottle" in dewatering flotation concentrate has nearly always been in filtering the thickened material. Centrifugal force is capable of packing the solid material against the walls of the centrifuge in an almost completely dewatered condition; and with ore products it is possible to pack them so tightly that a cold-chisel is almost necessary to remove them. Only a small centrifugal machine is needed to dewater a great amount of material, provided the thickened material can be removed quickly. Several machines for doing this promise to be of commercial utility, but none has been tested. It is my opinion that a centrifugal dewatering device should have a simple and continuous discharge of water and of dewatered product. Most inventors do not appreciate the difficulties incident to these requirements, and many futile proposals have been made.

Centrifugal filtration is an alternative to pressure filtration. In very finely divided material, the centrifugal filter plugs up with densely packed material, whereas a pressure filter may work well on the same pulp. For more granular material a centrifugal filter works well, and if a continuous discharge of the filtered solid and liquid products can be obtained, there should be a field for the centrifuge.

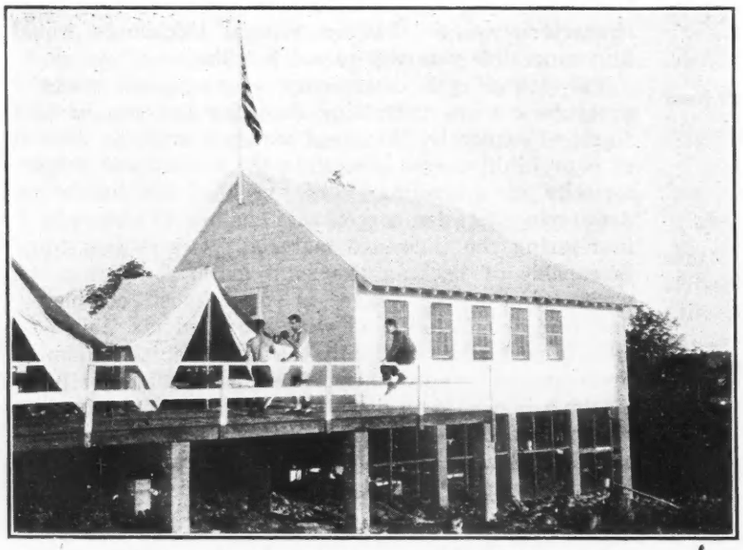
Centrifugal amalgamators doubtless have an excuse for existence. By the use of centrifugal force very small particles of gold and platinum, which tend to be wafted away by the water stream in which they are suspended, could be forced to come in contact with a live surface of quicksilver. Those particles which refused to amalgamate would sink in the quicksilver, owing to their specific gravity, but the gangue would not be able to do so. Several machines for this purpose have been invented, and although they have as yet found little use, a successful and widely used machine may be forthcoming. It should have a continuous feed and continuous discharge of tailing, but need not have a continuous discharge of the precious metal, amalgam, and mercury.

Centrifugal concentrators have been the dream of inventors ever since it was recognized that there was a problem in treating the slime formed in ore dressing. Flotation has given an answer to this problem for most of the sulphide ores and metallic minerals, and to some extent for oxidized ores; but in general the true slime in oxidized ore needs a different treatment.

Great sums of money have been spent in developing centrifugal concentrators; several have been or are near to being successful. An alternative to flotation would be welcomed in some quarters, both for technical and business reasons, and it is to be hoped that development of such apparatus can be continued.

Summarizing, it is possible to say that centrifugal clarification of water containing valuable minerals, centrifugal dewatering of thickened material, centrifugal amalgamation, and centrifugal concentration are the four uses of centrifugal force which seem to be legitimate, with regard to costs of operating centrifugal machines. Mechanical development of machines for these purposes is very expensive.

*By permission of the Director, U. S. Bureau of Mines.



Where drafting is done at the M.I.T. camp. Temporary dining quarters underneath.

M. I. T.'s New Summer School at Dover

Technology Establishes Camp Near Replogle Iron Mine to Give Students Experience in Surveying, Geology, and Mining and Milling Practice

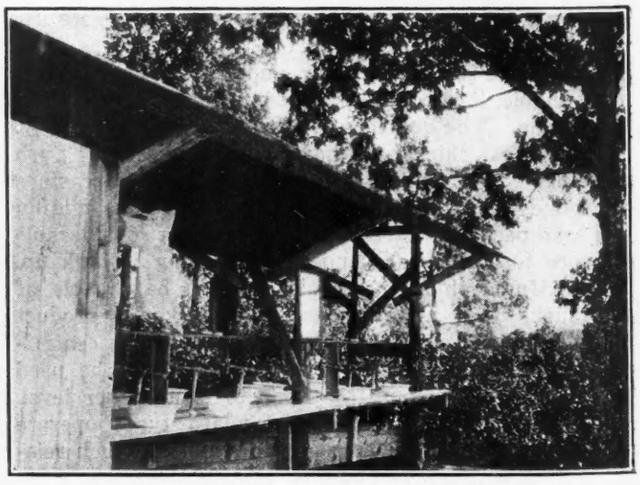
By A. H. Hubbell
Managing Editor

THE BIG THING in technical education is to extend the contact between the industry and the school so that the latter will better serve the industry in training men for its service. Acting upon this principle, the Massachusetts Institute of Technology has established a summer school near Dover, in New Jersey, not far from the Replogle iron mine—or the Scrub Oak mine, as it was called before its development along modern lines was undertaken by the Wharton Steel Co. On Sept. 21 the first session of this school came to an end, during which period the twenty-one mining students, with their four instructors, had an excellent opportunity to get experience in underground surveying and mining and milling practice. Plans for the future call for including geological field work, which was not attempted this summer.

In the past the mining students at "Tech" have gone to M.I.T.'s civil engineering summer camp at East Machias, Me. This is a much larger camp than the one planned for Dover. It has been customary to give the "miners" six weeks of surface surveying there and then to shift them to some mine for a two weeks' course in shaft plumbing, underground traverses, and the like. Until two or three years ago, the place selected was the old Pike Hill copper mine, near Corinth, Vt. Two years ago, however, M.I.T. was refused the further rental of the mine and was thus forced to look elsewhere. The Replogle mine was suggested, and through the good offices of Senator du Pont, a member of the Technology corporation, the facilities it offered for practical work were placed at the school's disposal by J. Leonard Replogle. This sufficed for the summer work in 1921. Last year the Alexandria mica mine, of the General Electric Co., near Bristol, N. H., was secured.

The need, however, of a permanent summer camp for such work was apparent, and after the members of the school corporation had been brought to see how useful such a camp would be, a modest appropriation was granted which made it possible to erect the present quarters, shown in the accompanying illustrations. The money has been wisely spent so as to secure the maximum good out of it the first year, and at the same time to establish the beginning of a camp that will meet the future needs of the school and which, incidentally, will require a much larger appropriation to complete in accordance with the plans.

When complete, the camp buildings, the site of which is only a short distance from the Replogle mine, where



Left—Tents erected in two rows on what will be the floor of the future administration building. Right—The wash house.

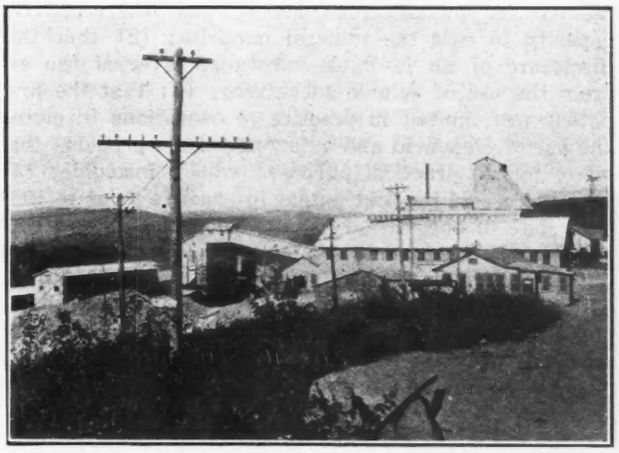
Students and instructors at the camp during the summer of 1923.

most of the students' work is done, will include an administrative building flanked on either side by wings 36x30 ft. in dimensions. One of these wings, already erected, will be used as a drafting room and was so used during the past summer. The other wing will serve for a dining hall. The space beneath the floor of the drafting room, which is carried on concrete columns, was utilized as a temporary dining room and kitchen during the summer. The foundations and the floor of the administrative building and its two wings have been built. The tents, sixteen or so in number, in which the students lived this summer, two in a tent, were erected on this floor, or platform, as the illustrations show. Here was a neat stroke of economy, for tent floors would have been needed in any case, and, it is said, would have cost about $60 per tent; the total amount thus saved was from $1,000 to $1,200. The administrative building will have a verandah across its full length.

Eventually, it is expected, the camp will accommodate forty-eight students. Present plans call for erection, on ground beyond the drafting building or wing, of four blocks of cubicles, each block 54x18 ft. and having six 9x12-ft. rooms with a 6-ft. porch stretching across the front of the block. Each of these twenty-four rooms will house two students. The camp is provided with electric light and running water. A wash house and latrine, already erected, complete the camp as it has been planned.

Success had in the past summer's work has been due to the co-operation of the instructing staff of the camp with the operating staff of the mine and with the students, as well as to the co-operation of the administrative officials of the Institute. The camp has been capably managed by one of the civil engineering staff of the school. The students have largely ordered their own affairs through an organization effected by themselves and patterned after that of the Institute itself. The various tasks of keeping the camp in condition have been apportioned among themselves and the jobs are rotated so that everyone gets his turn.

The curriculum calls for forty-eight hours work a week for eight weeks. Work is required two evenings a week for two hours in the drafting room. The students have Saturday afternoons and Sundays off. There is plenty to do in the spare time. Dover is only ten minutes distant by trolley, which runs close by the ten-acre tract that the Institute controls, and only 40 miles from New York. From the platform where the tents stand, the future verandah of the administrative building, a magnificent view is had of a great stretch of rolling country dotted with outcrops and scrub oaks—the same scrub oaks from which the Replogle mine got its former name.



Mining and milling plant of the Replogle (Wharton) Steel Co., near the camp.

Recent Flotation Litigation

By T. A. Rickard

VARIOUS FLOTATION LAWSUITS, between the Minerals Separation companies and the alleged American infringers of its patents, were settled on April 28, 1922, by a compromise, as my readers are aware. One litigation, however, survives: the case of Minerals Separation, Ltd., and Minerals Separation North American Corporation against Magma Copper Co., which owns an important high-grade copper mine near Superior, in Arizona. This legal fight was started over U. S. patents No. 835,120 and No. 962,678 on Jan. 10, 1920. It will be recalled that the first of these patents, the original one, covered the agitation-froth process with a "fraction of 1 per cent" of oil, whereas No. 962,678 purports to cover the use of a "soluble" flotation agent. Application for this patent was filed on April 30, 1909. The diagram that accompanied the application shows a beater form of agitator and "beating air into the mixture" is specified. Reference is made to "an organic compound in solution," and amyl acetate is mentioned. No particular proportion of this "mineral frothing agent" is stated, but it is contended that an increased proportion of the soluble substance does not interfere with the operation. The same patent (No. 962,678) was involved in the Miami suit, which went to judgment in two courts, adversely to the defendant company, but in that suit the first patent (No. 835,120) was the chief basis of the claim for infringement, on the ground that the use of a Pachuca tank and a centrifugal pump had produced the violent and persistent kind of agitation specified in that patent. The first patent, however, at a later date was withdrawn from the Magma suit, leaving only No. 962,678 in controversy.

Little New Evidence in Magma Suit

In the course of the Magma suit the plaintiffs have brought forward but little evidence in support of the validity of their patent (No. 962,678) that was not put forward in the Miami case. The main contentions are: (1) that the use of the words "oil-coated mineral matter" in the claims of the first patent (No. 835,120) connoted the use of an insoluble substance having a preferential affinity for metalliferous matter, and therefore the capacity to coat the mineral particles; (2) that this disclosure of an insoluble substance diverted the art from the use of soluble substances; (3) that the first patent was limited in practice to operations involving the use of oleic acid and a few petroleum products that were, for all practical purposes, wholly insoluble; (4) that the use of the first patent in practice prior to 1909 (the date of the second patent, No. 962,678) was confined to the treatment of zinc ores; (5) that the first patent was substantially "helpless" in the treatment of low-grade copper ores; and (6) that it remained for the disclosure of an organic mineral frothing agent in solution, under the terms of the second patent, to render the low-grade copper ores amenable to treatment by flotation.

Apparently, the record in the case does little to sustain these contentions, for the Court, in almost the last hour of the trial, said: "I am not quite clear in my mind as to what this patent will accomplish that the first patent won't accomplish, and why." Again the Court asked: "Does the testimony show that this other process of the first patent is helpless in the presence of porphyry ores?" To this counsel on one side responded in the affirmative, whereas counsel on the other side entered an equally decided negative.

Courts Seem to Be Much at Sea

The pathetic position in which the courts, unversed in the technique of metallurgy, have been placed repeatedly in the course of the flotation litigations is illustrated by this incident. In which connection another query is worth quoting: The Court asked: "If this patent did not accomplish any more than the first patent, would you then claim this was a valid patent and an invention?" To this counsel for the plaintiffs replied that the second patent "has thrown open to the use of the world this whole subject of cheap oils," the suggestion being that only oleic acid could be used under the terms of the first patent. The Court was favored with a demonstration of the use of oleic acid on Broken Hill ore and of X-cake solution (which is used by the defendant company) for the purpose of showing that the froths were different. The Court had to ask the plaintiff's demonstrator, Mr. A. H. Higgins, in what respect they were different, and was informed that one froth was a little lighter in color than the other.

These judicial efforts to understand the technique of the art of flotation suggest how ill adapted, as I have said, are the ordinary courts of law to direct a highly technical inquiry into the validity of a metallurgical patent. I am reminded of an incident that occurred in 1913 in London during one of the lawsuits between the Ore Concentration Co. (owning the Elmore patents) and Minerals Separation, Ltd. In this suit the use of oil, in the form of oleic acid, had been described repeatedly. Near the close of a hearing before the Judicial Committee of the Privy Council, old Lord Halsbury (a former Lord Chancellor) asked in a squeaky voice: "What is oleic acid?" He was puzzled by the fact that an "acid" was an "oil." "What is truth?" said Pilate on the occasion of a celebrated trial. "What is science?" may well be asked by those who have waded through the exhausting records of these flotation litigations.

Solubility and Miscibility

To this one might add the not altogether unintelligent query "What is solubility?"—a question that might well be addressed to Mr. Sulman, for in U. S. Patent No. 962,678, he mentions phenol and its homologues among the soluble frothing agents, with the further statement that all previous processes of flotation have employed oils that were immiscible in water, whereas in patent No. 777,274 the claim is made that phenol and cresol (a homologue of phenol) are liberated in an insoluble condition in the pulp by the addition of their alkaline compounds to an acid pulp. The truth is that phenol is soluble in the proportion of about 6 grams in 100 grams of cold water, and much more so in hot water. Cresol is less soluble, but is completely soluble under the conditions usually obtaining in the operation of a flotation plant.

Next comes the question of miscibility, with which solubility is easily confounded by the average millman. And then comes the question, not yet settled, as to how large a part solubility and miscibility, surface tension and viscosity, and various other physical phenomena play in the flotation process. So long as the physics of froth and the cause of its effectiveness as an agent in concentration remain a muddled guess, it is plainly impossible to adjudicate intelligently on the nice technical questions involved in these litigations. When first they started, oil was the prime agent, so it was supposed; then it was found that sea water without any oil served for the concentration of certain kinds of copper ore; then various organic compounds with no resemblance to oil were proved to be efficacious.

Compromise of 1922 Relieved the Mining Companies

Anybody that has waded through the records of the various lawsuits, the testimony and the adjudications, will be astonished at the contradictory evidence, the diverse opinions of the courts, and the repeated shifting of the plaintiffs in their contentions. Fortunately, the uncertainties of the law and the need for a settlement were realized at a late date, so that, early in 1922, most of the lawsuits were dropped by mutual agreement and a compromise was effected, relieving the mining industry of much harassment, but not of its obligation to pay royalties to the Minerals Separation company.

To the contention of the plaintiffs in the Magma suit, it was urged by the defendants (1) that there is no necessary implication of insolubility from the use of the words "oil-coated particles"; since a substance in solution may be adsorbed upon the mineral particles in the pulp, and thus coat the particles with the infinitesimally thin film contemplated in these processes, and that such adsorption is effected on the mineral particles, in preference to the gangue; (2) that many, if not all, of the substances disclosed in the first patent, and in the art prior thereto, are wholly or partly soluble in the proportions used in the process of the first patent, and that there is no necessary tendency in the disclosure of the first patent to direct the art away from the use of such partly soluble substance, because, on the use of such substances (containing both soluble and insoluble elements) the coating would have been effected, and the froth produced, without any necessary determination by the millman of the forces actually responsible for the result; (3) that, whereas the first patent was limited, prior to 1909, in its application on a commercial scale, to the few plants operated under the direction of the Minerals Separation company in Australia, and although it is true that in such plants oleic acid and petroleum products were used, it is true nevertheless that in 1907 the fact was known to H. L. Sulman, one of the patentees of both the first and the second patent, that several oils had been found effective in the process of the first patent, and it is true further that in the operation of the Elmore vacuum process, a froth-flotation process operating in active competition with the first patent, a large variety of partly soluble oils, including tars, blast-furnace oils, and many light oils, had been tried and found useful in practice; (4) that, although the commercial use of the first patent may have been limited to the treatment of zinc ores, the Elmore vacuum process, prior to 1909, had been applied successfully to low-grade copper ores in Norway and Sweden; (5) that, although it is true that oleic acid and the almost insoluble petroleum products were not highly efficient in the treatment of low-grade copper ores, it does not help the plaintiff to state merely that the first patent was helpless in the treatment of such ores, because this assumes that the first patent is limited to the use of oleic acid and the almost insoluble petroleum products, and excludes therefrom the use of wood-tar and coal-tar products. As this is the principal issue involved in the case, any such statement is an assumption; and (6) that, since substantially all flotation of the low-grade copper ores has been accomplished by the use of wood-tar and coal-tar products, it cannot be said that the successful treatment of such ores had to await the disclosures of the second patent.

To most of those conversant with the subject it will be a matter of surprise to learn that the problem of flotation as applied to low-grade copper ore was solved by the disclosures of the second patent. The only testimony apparently in favor of this contention is that of Mr. G. A. Chapman, to the effect that he went to the Inspiration mill in 1913 and there started experimental work, using cresol on the ore of the Inspiration mine. He did not claim that this was the successful flotation agent used in the experiments nor that, as a result of experiments, it was the one selected for use in the Inspiration mill when it started to work; in fact, he admitted that it was not selected. The fact is that of the experimental work done at the Inspiration mine, with a view to the selection of methods to be used in the mill, only a small part was done by the representatives of the Minerals Separation company, although to Mr. E. H. Nutter is to be credited the first successful experiment in the flotation of chalcocite ore, in November, 1912, at Inspiration, that is, several months before Mr. Chapman introduced the use of cresol. The facts were related in detail by me in the *Mining and Scientific Press* of March 18, 1916. It appears from the record that the Inspiration plant never used wholly soluble agents, but in the main depended upon coal-tar creosotes. Here it is proper to note that William Haynes, in his British patent of 1860, was the first to employ oil for a metallurgical purpose, and that he used coal tar from gas works. Coal tar contains as much as 20 per cent of soluble products. Moreover, in U. S. patent 788,247, dated April 25, 1905, Cattermole, Sulman & Picard used cresol and phenol, both soluble in water, as agents for modifying the surface tension of the water used in flotation.

Did the Elmore Process Produce a Froth?

In the Magma suit the disclosures of the Elmore vacuum process (the American rights to which were purchased by Messrs. D. C. Jackling and J. Parke Channing for their companies in May, 1915, for $50,000) were used by the defendant to prove that it antedated patent No. 962,678. Elmore used "tars and blast-furnace oils" and produced a froth, which served as the agent of concentration. To this the plaintiffs demurred, arguing that the Elmore vacuum process was not a "froth-flotation" process, and that the term "blast-furnace oils" indicated dead oils, from which the tar acids had been extracted. As to the froth of the Elmore process, I can quote Mr. C. Terry Durell, who stated, in 1916, that when he studied the process at Broken Hill he found it was "another method of making bubbles and froth," which was more persistent than the froth produced in the Delprat process.

As to the blast-furnace oils, it is pertinent to quote Lunge, who in 1900 described them as including creosote

oils containing from 25 to 30 per cent of tar acids. In argument, counsel for the plaintiffs contended that inasmuch as Elmore speaks of "greasing" the particles of ore, he would necessarily have been directed away from the use of the partly soluble blast-furnace oils and to the dead insoluble portion of such oils. This contention is made in the face of the fact that the partly soluble blast-furnace creosote oil would have produced the "greasing" to which Elmore refers, and, moreover, the argument assumed that the exponents of flotation had expressly accepted the factor of insolubility prior to the patent in suit, whereas there is nothing to support such a contention except the use of the terms "preferential affinity" and "oil-coated with mineral matter," both of which phrases are exemplified by the partly soluble substances mentioned in the first patent (No. 835,120). The fact is that so long as the basic cause of flotation is not clearly understood, these attempts to split technical hairs are futile.

Mr. Sulman's "Unpublished Book" Enters the Case

In the Magma suit, several interesting exhibits appeared, notably the Elmore article appearing in the issue of May 11, 1907, of the *Engineering and Mining Journal*, disclosing the use of tars, blast-furnace oils, and a number of light oils in the vacuum process. Another exhibit is the treatise written by Sulman and Picard in 1906; a copy of this "unpublished book in manuscript form" was given to Theodore J. Hoover by its authors early in 1907. The treatise is a complete disclosure of Mr. Sulman's knowledge of flotation seventeen years ago; he states therein that the Froment process (patented in 1902) was a froth process, embodying the same principles as No. 835,120; and that the Elmore vacuum process is another froth process, involving the same principle. The treatise proves Sulman's familiarity with a number of flotation agents and a recognition of their availability for use in the concentration of ores by flotation. These agents include the phenols and cresols, the wood-tar and coal-tar products, as well as the other agents that are specifically named in the various patents he discusses, including No. 835,120 and its predecessor, the Cattermole patent of 1903.

Conditions of the Anaconda Agreement

When the settlement of litigation between Minerals Separation and the Hayden-Jackling companies, as well as the Miami company, was made, it was arranged that these mining companies should take out a license from Minerals Separation and at the same time enter into special agreements. The effect of these agreements was to place the companies in exactly the same position as the Anaconda company, which, it will be recalled, made a settlement and contract with Minerals Separation in 1915. Previously, in 1913, the Inspiration company had entered into the regular form of license agreement, which had all the obnoxious features and carried a rate of 12c. per ton of ore treated. The Anaconda company, in 1915, made a group agreement with Minerals Separation under which the Anaconda, Inspiration, and other subsidiary companies were to enjoy the benefits of a graduated royalty, the practical effect of which, on a normal aggregated tonnage, was to give these companies a 4c. rate. This group agreement was made dependent upon a decision in the Hyde case favorable to Minerals Separation. Shortly after the Supreme Court decided in favor of Minerals Separation, in December, 1916, it was arranged between the parties to extend the group agreement until the expiry of patent No. 835,120. Under this arrangement the Anaconda agreement was to terminate on Nov. 6, 1923, so far as the treatment of copper ores is concerned, but the Anaconda company has the privilege of continuing the license contract upon the same terms. Subsequent to this the Anaconda company took out a license for zinc flotation, with a special agreement under which it secured a special zinc rate. This license and agreement were to terminate at the expiry of the soluble frothing-agent patent (No. 962,678) in 1927. This zinc agreement also provided that nothing therein contained should in any way abrogate or cut down the rights of the Anaconda company under its copper license agreements. All this left the Anaconda in a position in which it was able to contest the validity of patent No. 962,678 after the lapse of patent No. 835,120, even though it was compelled under its zinc license agreement to pay royalty until the expiry of the "solution" patent in 1927. When the Hayden-Jackling copper companies, and the Miami, made the settlement with Minerals Separation, it was specified that in the event of Anaconda disputing the validity of the second (or soluble frothing-agent) patent after November, 1923, these mining companies had a right to deposit their royalties in trust and to join with Anaconda in contesting the validity of patent No. 962,678. It was specified that the covenants of the license agreement inconsistent with this right were to be to that extent suspended. All these agreements will, I presume, become a part of the record in the Magma case.

Magma Decision Will Be Important to All Users of Flotation in this Country

The judgment of the Court in the Magma case cannot be anticipated; no judgment of any court in these flotation suits comes within the scope of intelligent prediction. The patent (No. 962,678) now in controversy may be declared either valid or invalid, or its range may be limited to the use of a wholly soluble agent. The first patent (No. 835,120) lapses on Nov. 6, 1923. I have received letters asking me whether persons operating flotation plants under license from the Minerals Separation company will be obliged to pay the royalty after the date of expiry of the basic patent.

The answer is in the affirmative if the courts sustain the claims made by the Minerals Separation company under patent No. 962,678, but it is probable that, even if the result of the Magma litigation should validate this patent, its operation will be restricted to the use of a wholly soluble agent, in which event the users of flotation can fall back on coal-tar and wood-tar products, including blast-furnace oil. Here it is proper to note that the U. S. Department of Agriculture, in a bulletin issued in August, 1907, recognized the production of pine oil on a commercial basis for several years previously and therefore that at the date of the first patent pine oil was commercially procurable. In view of this fact, and the Supreme Court's decision that pine oil is an agent of the process of the first patent (No. 835,120), it would seem incorrect to say that the successful treatment of the so-called porphyry copper ores had to await the disclosures of the second patent (No. 962,678). Of course, freedom from the threat of litigation is worth something, and it may be that most operators will be willing to pay a reasonable royalty rather than have their affairs tied in a knot by litigation. It is to the interest therefore of the principal users of flotation to co-operate with a view to self-protection.

USEFUL OPERATING IDEAS

The Ring Hitch

BY GEORGE J. YOUNG

The article by John Kruttschnitt on securing pack loads in the Aug. 4, 1923, issue of the *Engineering and Mining Journal-Press* (page 198) is of interest in that it contributes to an obscure subject. Many kinds of hitches have been devised and used by western packers. The diamond hitch, one of the best known, is effective, but unless one has had considerable experience in packing it is difficult to remember, and as a consequence a variety of more or less effective substitutes are in order. Two years ago, having occasion to pack several mules, I devised a simple substitute for the diamond hitch. Apparently the scheme works well. At least it has proved effective on comparatively short trips. It applies to the usual side bags and top load.

The important feature is a ring 3 in. in diameter. In applying the hitch, the tie rope is looped over the hook of the cinch and tightened; the free end of the rope is looped and passed through the ring, the loop being given a single twist and passed around one bag. The free end of the rope is then passed around the other bag and secured to the ring. The loop about each bag is drawn tight and all of the slack taken up. A simple tie, shown in Fig. 1, secures the rope end. Pulling the loose end releases the tie rope and unhooking

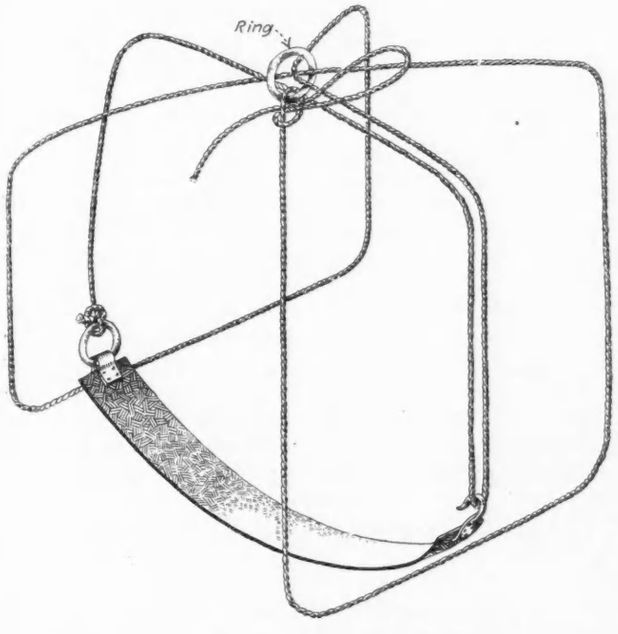


Fig. 1.—Single ring hitch

the loop allows the tie rope to be lifted off from the pack. A modification of this hitch is shown in Fig. 2. In this arrangement two rings are fastened to a short broad strap. This is placed on top of the pack and the tie rope is placed in position by thrusting a loop through both rings and securing it to the cinch hook. The rope is tightened and the free end is passed around one bag, through the rings and around the

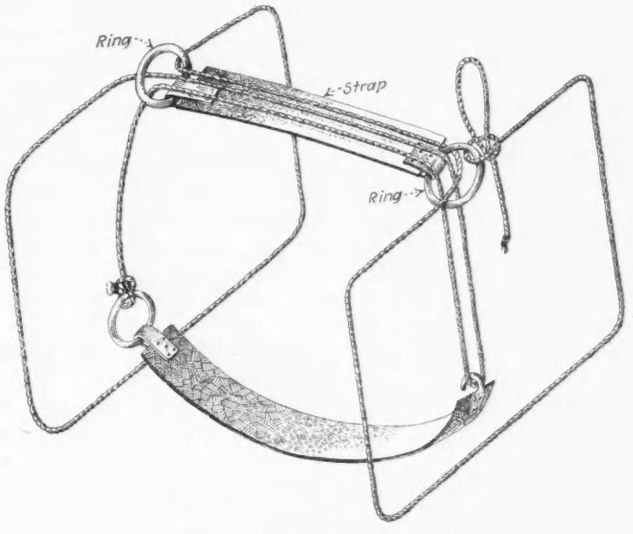


Fig. 2.—Double ring hitch

other bag, and secured at the ring. Both arrangements are original, as I have seen no description of either. I have never tried out the double ring hitch.

How to Temper ⅞-In. Hollow Steel Drill Heads

BY S. L. BAKER

To temper ⅞-in. hollow steel drill heads, first punch a hole in the end large enough to protect the needle when the chuck gets worn a little. Then file perfectly level and do not trust any method except using the eye for leveling up the ends. I find this is a very important part. Then heat in a coke fire to a light red, almost to a scaling point, but not quite; heat clear down to the shank, then immerse ½ in. in water for about a half minute, or a little longer, if the temper comes down too quickly the first time; then take out of the water and rub the end on the anvil block or on something that will brighten; but always let the water dry off the end before rubbing to brighten.

Then let the temper draw down until the end is almost purple but not quite; then go back to the water with it the same as before. This time do not leave it in the water quite so long; then rub the end as before, but let the water dry first; then rub well this time and watch it closely. When the purple gets all over the end that has been brightened, go to the water as before, this being the last time; leave it in the water about two minutes, then take out and set away and let cool gradu-

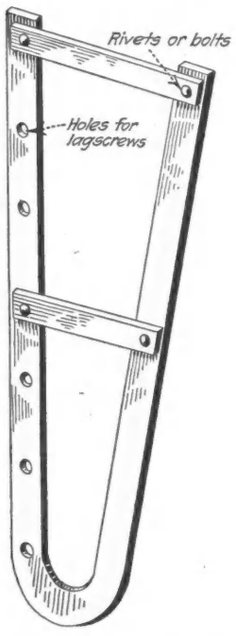
ally. There will be no more trouble with the drill heads battering or breaking if the procedure as outlined here is followed.

Make a holder for the side of the water tub as large as the outside diameter of the drill steel. The shank part of the drill rests in this and keeps the drill only half an inch below the surface of the water when the water is kept in the tub at a definite level.

A Chute Hook Made of Band Iron

BY CECIL ROWE

A chute hook which I have used for years and found to be very satisfactory is made of ½-in. band iron, usually 2 in. wide, and bent in the form of a V, as shown in the figure. One of the hooks is fastened on either side of the chute by means of lag screws, through the holes drilled for this purpose. The strap across the top is used to strengthen the outer side and keep the hook rigid. The lower strap serves a twofold purpose — first, to strengthen the hook and, second, to form a rest for the chute planks, making it unnecessary to remove more than the lower one or two planks when drawing the chute. The plank or planks above the lower strap are usually left in place, and when large pieces are to be drawn the plank may be worked up and down, allowing the chute to be easily drawn.



Band iron bent to form chute hook

With these hooks and using the average labor I find that there is little trouble from failing to stop the chute and thus allowing the muck to pile up in the drift around the car. The use of this simple device will result in almost complete freedom from this annoyance. It is not offered as being something new and extraordinary, but it is simple to make, and many mines have troubles in drawing chutes which could be obviated largely by such a device.

Hitch Cutting in Shaft Work

An arrangement for adapting the jackhammer type of drill to hitch cutting in shaft work has been devised by Ott F. Heizer, of Tuolumne, Calif. The rotating mechanism of the drill is removed and a hanger, shown in the figure, is slipped on the side rods. The drill is suspended by a chain attached to the hanger, and a sprag is wedged at a convenient point above the hitch. This leaves the drill free to be moved about with the chain as a radius. It can be angled up and down and sidewise, thus enabling the miner to chip out the hitch.

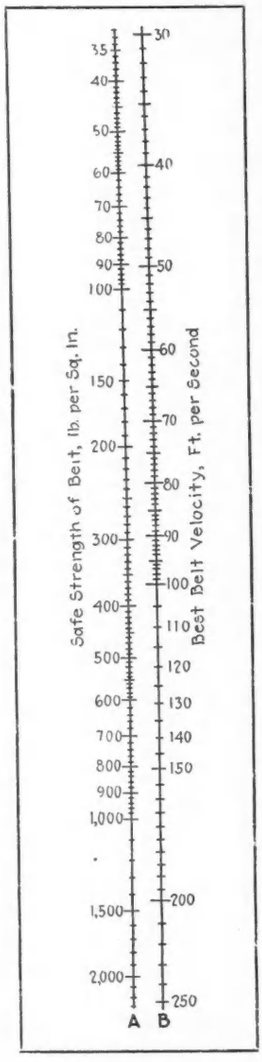
Attachment for jackhammer drill

The Best Speed for a Belt

BY W. F. SCHAPHORST

Copyright 1923 by W. F. Schaphorst

Centrifugal force will break any belt, if the speed is high enough. A leather belt of 1,000 lb. breaking strength per square inch will give way, for instance, without pulling an ounce of load when running a trifle over three miles per minute. Somewhere between zero velocity and three miles per minute there is the most efficient speed for such a belt, where the belt will transmit the most power. The accompanying chart gives the best speed for any leather belt of known safe strength. Find the strength of the belt in column *A*. Column *B* will then give the best velocity. All you need do is to glance from column *A* to column *B*. For example, if the safe strength is 200 lb. per square inch (which would be a second-class leather belt), the best velocity is 74 ft. per second. Since cotton and canvas belts often weigh the same per cubic inch as leather belts, this chart is equally applicable to such equal-weight belts. It is assumed that the belt is not subject to needless initial tension in addition to the tension of centrifugal force and the load tension on the tight side. If there is initial tension it is difficult to tell just what the best speed would be, because such practice sometimes breaks belts even before they do any work at all. Certainly, high initial tension reduces the best speed to a much lower figure than that given in this chart.



Strength-velocity chart for belts

This chart should prove to be an important aid in the selection of belts and pulleys. It shows clearly the advantages of strong belts, and high speed means high power. It shows that new strong belts should be run at high speed. As they grow older and weaker they can be used on slower drives and replaced on the high-speed drive by new and stronger belts.

Addition of Zinc Dust to Cyanide Solution

BY FRED C. BOND

Anybody accustomed to add the zinc dust necessary for precipitation of silver from a cyanide solution through one of the chambers of a triplex pump will be familiar with the wear caused by the sharp-edged adhesions of zinc and silver to the plunger surface. This trouble may be entirely obviated by the use of a porcelain plunger in the chamber to which the zinc dust is added. The saving in packing material will soon pay the cost of the plunger.

THE PETROLEUM INDUSTRY

Recent Exploration for Petroleum in the United Kingdom

DURING the summer and winter of 1918 eleven standard rigs were erected in the United Kingdom to test the petroleum prospects of ten structures, eight of which were in England and two in Scotland, according to E. L. Ickes in a paper presented at the Tulsa meeting of the A.I.M.E. last week. By the fall of 1921 ten of the wells were completed; the remaining one, the D'Arcy, in Scotland, was stopped some months later. The tests were deep ones, five of the wells being 4,000 ft. or more, the rest varying in depth between 1,810 and 3,918 ft. The total footage drilled was 40,047 ft. The holes were put down with standard or cable tools purchased in the United States (except the bailers). The larger sizes of casing, 10-in. and above, were also from America; the smaller sizes from Scotland.

The Hardstoft well, in England, found a small production of high-grade oil, and the D'Arcy well also encountered what is reported as a favorable showing at a depth of 1,810 ft. The Werrington and West Calder wells had to be abandoned on account of drilling difficulties. The Apedale well encountered great thicknesses of ash in the Carboniferous and had to be abandoned on account of depth. The results might be summarized by saying that of the ten structures drilled upon, two yielded encouraging showings; three cannot be considered as having been adequately tested; and five produced dry holes, although in some of these small oil showings and gas were met.

The total cost of the work amounted to about half a million pounds sterling, which sum includes the cost of all equipment, subsequently sold by the government. The work, under the superintendence of V. L. Conaghan, took place for the most part in the period immediately following the war—a period of high prices, labor and transportation difficulties, and unsettled conditions.

The English wells were located in the Midlands, an important industrial region occupying the heart of England about 125 miles northwest of London. In point of superficial distribution and structure, England may be divided into two parts: The flat-dipping Mesozoic and Tertiary rocks covering the eastern, southeastern, and southern parts of the country and the outcrops of Carboniferous and older rocks which form the western and northern portions. The older areas show more deformation and usually give rise to a more rugged topography. Belts of Mesozoic also occur in the older rocks and a notable depression filled with the younger formations crosses the country, in a northwesterly direction, through the south Midlands, Cheshire, and Liverpool, and separates the older rocks of Wales from those of central England.

The two groups are separated by a marked unconformity. Borings starting in the Mesozoic, on reaching the Paleozoic floor beneath, sometimes encounter Carboniferous, as in the case that led to the discovery of the concealed Kent coal field southeast of London; or the drill may strike Devonian, Silurian, or other formations, which make up the floor upon which the younger rocks are resting.

The outcropping rocks of the north of England are moderately deformed Carboniferous. Along the Scottish border, these are interrupted by a wide belt of highly folded Silurian with a northeasterly trend; beyond this belt in central Scotland, the Carboniferous reappears in an isolated basin in the vicinity of Glasgow and Edinburgh. On account of this interruption in their continuity, there is some difficulty in correlating the Carboniferous members of the two countries.

All the borings started, and presumably ended, in the Carboniferous. Those in England were in two groups: one on the east side of the Pennines, in Derbyshire, the other on the west side in North Staffordshire. The Scottish wells were located in the Carboniferous basin near Edinburgh.

The Pennine Chain is sometimes referred to as the "backbone" of England. It starts north of Derby, coincident with the appearance of the Carboniferous, and continues north through the mid-portion of the country to the borders of Scotland as a series of hills and table-lands rarely attaining an elevation over 2,000 feet.

Oil manifestations of various types can be said to be of general occurrence in certain districts of the United Kingdom. They range in character from veinlets and fragments of bitumen and wax through outcropping oil sands to actual seepages. At some place or other, practically every formation from the pre-Cambrian to the Cretaceous can be found to contain one or more of these types. A characteristic of most of the fluid varieties from the Paleozoic is the high wax content, causing the oil to set at ordinary temperatures. Many occurrences have been discovered in coal and lead mining operations, from early times; most of the indications have been found associated with the Carboniferous and mostly in the Midlands and Scotland.

As to the significance of the various oil indications in the United Kingdom, this perhaps will not be well understood for some time to come. As some critics have maintained, are these indications of no value or do they indicate that the country as a whole is a dead oil field and past hope of ever being commercially productive? Certainly at some former periods in the history of the country, valuable deposits must have existed, and the Hardstoft well should help invalidate the view that these have all disappeared or become "inspissated." Any one acquainted with the hazards of wildcat drilling will acknowledge that eleven scattered wells are insufficient to test thoroughly a country having the size and geological conditions of the United Kingdom. The method of balancing the books by taking the difference between the cost of the prospecting to date and the return in oil sold, and writing it off as a loss is, if anything, premature. It would be more reasonable to let the balancing rest with the future, until more work may have been done.

Promising Places for Oil in Moffat County, Colo., Indicated by Geologists

Early in August, 1923, high-grade oil was encountered in a well drilled by the Texas Production Co., on an anticlinal fold known as the Hamilton dome, about 13 miles south of Craig, in Moffat County, Colo. The oil was found at a depth of about 2,020 ft. in beds that lie about 3,000 ft. below the top of the Mancos shale, and its presence there was not suspected, for the beds that seem to hold the most promise for oil lie near the base of the Mancos shale, 2,200 to 2,500 ft. deeper. The possible amount and value of the oil is not yet known, but even if the oil found is not sufficient in quantity to be of commercial value its occurrence naturally inspires hope that oil in greater quantity may be found in deeper beds, both in the Hamilton dome and in other anticlines in Moffat County.

Parts of Moffat County were mapped during the summers of 1921 and 1922 by a party of the U. S. Geological Survey, under the direction of J. D. Sears, who is now preparing a report on the area. This report shows that about 5 miles southwest of Hamilton dome there is another dome, the Seeping Spring Gulch dome, which in some respects is even more attractive than Hamilton dome as a place to search for oil, and that these two domes are apparently more favorable for oil than any other anticlinal folds in the area studied by Mr. Sears' party.

The Mancos shale and the Dakota sandstone are the formations that are most likely to yield oil in the Hamilton and Seeping Spring Gulch domes, but oil may possibly occur in the Nugget sandstone, of Jurassic age, which can be reached by very deep drilling.

Corsicana-Powell Field Extended—Important Wells Completed Elsewhere

The Corsicana-Powell field, in Texas, has recently been extended one-half mile farther to the southwest. During the first week in September the production jumped to 187,775 bbl. daily. Predictions have been made previously that the peak of production had been reached; this prediction is again made, with more assurance, for during the following week the average daily production fell off nearly 50,000 bbl. Some water also showed in several wells. It is believed, however, that a considerable production will be made eventually from the shallow sands, ranging in depth from 586 ft. to 1,700 ft. These have been passed up for the present in the rush to make large flowing wells from the Woodbine sand at 2,830 ft. to 2,990 ft.

Important wildcat wells have been completed in Young County, eight miles south of Newcastle; in Falls County, between Marlin and Chilton; and in southern Scurry County. In addition to these potential producing areas, a new deep sand has been found at Mexia, in the Humphreys-Kendrick No. 1 well at 4,550 ft. While the total production of the state is decreasing at present, these discoveries, it is believed, will eventually add greatly to the state's output.

The outstanding event recently in the Gulf Coast oil belt was the completion of a well in the Big Creek field, Fort Bend County, by the Gulf Production Co. This well, No. 6 Davis, is 4,000 ft. north of the first well brought in, and came in making 800 bbl. of 32 Bé. oil from 3,800 ft.

At Orange a new deep oil sand has been opened at 4,370 ft., in the Supreme Oil Co.'s No. 4 Jackson well. This well made an initial flow of 1,000 bbl. per day. Several other good wells have been completed recently, among them the Brownie-Rabbett Oil Co., No. 9 McLean, making 1,200 bbl. from 3,585 ft.; Sun Co. No. 4 Gunstream, 1,600 bbl. from 3,525 ft.; Gulf Production Co. No. 11 Hager Fee, 2,500 bbl. from 4,000 ft.; and Rycade Oil Co. No. 6-A State, 1,600 bbl. from 3,540 ft.

The wildcat well of the Gulf Production Co. on the newly discovered salt dome 5 miles east of Boling, Wharton County, tested salt water at about 480 ft. after making a little oil.

Osage Royalty Oil To Be Stored

To assure the sale of oil for the benefit of the Osage Indians of Oklahoma, instead of selling their royalty oil at the prevailing low prices, Secretary of the Interior Work has authorized its storage until there is improvement in the crude oil market. Arrangements for such storage have been made.

This action by the Secretary will undoubtedly result in a substantial saving to the Indians, as in April the average price obtained for their royalty interest was $2.11 per barrel. In May the price dropped to $1.81 per barrel, with a further decline to $1.75 in June. This difference in prices on the royalty interests of production would approximately be $200,000 per month.

Production of oil on the Osage Reservation totaled 3,439,584 bbl. for the month of June and 3,830,485 bbl. in May of this year, according to the Indian Bureau of the Department of the Interior. Royalties collected for the Osage Indians from both oil and gas for these months amounted to approximately $1,360,000 in June and $1,430,000 in May. The enrolled Osage Indians originally numbered 2,229, and they or their heirs are paid their share of bonuses and royalties from oil and gas received from their lands quarterly by the government. For the three months ended June 30, 1923, each share aggregated $4,000.

Since 1901, when oil was first produced in the Osage, there have been approximately 223,000,000 bbl. of oil extracted, and the bonuses from sales and royalties on oil and gas marketed have aggregated over $140,000,000. The principal part of such oil and gas has been produced during the past eight years, there being about 9,000,000 bbl. produced during 1917, while 42,000,000 bbl. of oil and about 27,000,000 cu.ft. of gas were produced and marketed during the past year.

Orallo District, in Queensland, To Be Prospected

Duncan Milsom, general manager of the Lander Oil Field (Australia), Ltd., who has been engaged in oil prospecting at Orallo, in the Roma district in Queensland, has returned from a visit to Los Angeles, Calif., where he bought a rotary drilling plant for his company, and has gone on to Orallo. Nearly all of the plant is now on the field, the rig is being erected, and it is expected that boring will be in full swing by the end of next month. The plant and its erection will cost about £25,000. Dr. Milsom has entered on his company's venture with energy, and is confident of success. At any rate it is certain that the Orallo country, which is about 30 miles from the now abandoned state oil well at Roma, will be thoroughly tested for oil.

DISCUSSION

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

U. S. Treasury's Far Eastern Exchange Transactions in 1919-1920

Record Indicates That Heavy Additional Silver Purchases Under the Pittman Act Will Be Required

THE EDITOR:

Sir—The most important sales of silver in world history (exceeded in volume only by the war-time sale for India account in 1918, the first sale under the Pittman Law) comprised 82,062,996 U. S. standard silver dollar coins secretly sold between the approximate dates Nov. 25, 1919, and Feb. 27, 1920. The initial sale of $3,000,000, seemingly omitted from Treasury records, may bring the total up to $85,062,996. They were sold by and out of the Treasury, for use as bullion in China. The purchasers were leading New York banks, or rather, their China branches or subsidiaries. The government received for those coins dollar for dollar, which means 1.29\frac{3}{16}$ per fine ounce silver bullion. The government was also guaranteed half the profits in a contract with three of the leading banks, dated Dec. 6, and amended Dec. 8, 1919.

The only purpose ever announced by the government was to "employ such dollars in regulating our exchanges with silver standard countries." The actual facts, which will be shown, show a most extraordinary emergency in 1919 and 1920. Silver rose to a premium owing to high trade balances owed to silver-standard Asia. The metal commanded the highest prices since the sixteenth century. Gold had become the "cheap monetary metal" in the British Empire, America, and most of the rest of the world. The high price of silver might prove a menace to the circulation and parity of silver coins and conceptions of the "gold standard." The high price of the Asiatic exchanges, and depreciation of our gold dollar there (to only 43c. of its pre-war value, whereas our gold dollar commanded a premium in most of the world) might prove a menace to commerce.

The available supplies of silver to pay Asia were inadequate. The drain of gold from the Occident, that could not spare that gold, but had to sink it in Asia in lieu of silver, attained staggering proportions. It reached by February, 1920, a rate of over $1,000,000,000 yearly sunk in India alone. To pay for gold that month caused the monumental collapse of the pound sterling and most exchanges of Europe to the lowest in history, and the loss of gold reserves to less than the legal minimum at the great Federal Reserve Bank of New York! It ushered in the "deflation" panic of 1920 that affected worldwide trade.

Some time before the crisis reached its virulent stage, an agreement was reached, on or about Nov. 10, 1919, between the U. S. Treasury and the China-American banks to employ the Pittman Law. The law permits the Treasury to put silver dollar pieces on the market, as bullion, at any price not less than $1 per fine ounce; 89,876,246 coins remained yet to sell at that time within the law's limit. That amount of silver (and perhaps more, by amending the limit salable) would, if put on the silver market, reduce the premium on silver, stabilize the Asiatic exchanges, permit settlement of trade balances in silver, conserve gold, and protect our coinage and currency systems. It served all those purposes. The banks agreed to melt the dollars here or in China before their resale as bullion in China. The Pittman Law authorizes the Secretary of the Treasury to melt the dollars; but the sale law and three other laws constitute the banks his proper agents. The Pittman Law requires repurchase of silver from U. S. mines to replace each and every coin sold and destroyed.

NO REPURCHASE INSTRUCTIONS

There never existed any intention to deny repurchase. However, repurchase instructions were never issued. The entire transactions remained forgotten till the writer called Senator Pittman's attention thereto, on July 11, 1923, which was followed by a first hearing on the subject July 18, 1923, by the Senate Commission of Gold and Silver Inquiry, at which most of the records and all the early correspondence were withheld and suppressed. Because of that suppression, the then Acting Secretary of the Treasury, the Hon. S. P. Gilbert, Jr., was misled into asserting that the Pittman Act was never "in any way referred to." The record of fact shows that no other authority was ever referred to, except the Pittman Law.

One reason why repurchase instructions did not issue, as the Pittman Law makes mandatory, was due to the delay in receiving from China notice of actual meltings, and verification thereof. Under the law silver is repurchaseable to replace only such coins as are melted or broken up and destroyed, for their sales as bullion. Another combination of reasons why repurchase orders did not issue was the intense secrecy practiced at every sale to protect against loss the banks which were co-operating with the Treasury, and then at the end of the sales a complete change in Secretary of the Treasury, and also Under Secretary; and resignation of Vice-Governor Albert Strauss of the Federal Reserve Board; all the government's administrators of the Pittman Law; and the death Jan. 6, 1920, of Edward Brush, vice-president of the American Smelting & Refining Co., dean of the silver bullion trade, who looked after the interest of the mining, smelting, and related industries.

To replace the entire $82,062,996 would require repurchase of 63,410,598 fine ounces of silver, at $1 per ounce, the product of U. S. mines and works; would give our industries the benefits of "dollar silver" for twelve months; would cost the government nothing and show

the government about $19,000,000 coinage profit; and would provide no more silver dollars and certificates in circulation than existed when the Pittman Act became law, and even fewer than are needed today. However, many of the dollars were not destroyed; and there is doubt if their replacement, or repurchase of silver, is compulsory under the Pittman Law, as to non-destroyed coins. The evidence is conclusive, however, that a *minimum* of 28,306,466 coins were actually melted and destroyed in China and Hongkong by the purchaser banks, acting as proper agents of the Secretary of the Treasury, and must be replaced—21,983,282 fine ounces.

Because repurchase of that silver, whether the minimum or full amount, is the biggest item in the world of silver today so far as concerns the American industries, and because applicability of the Pittman Act has been questioned, a record of facts as to the sales and the law is in order.

How a Crisis Was Met

Before the 1919-1920 crisis became virulent, but correctly anticipating it, the proposal was made by leading gold-standard bankers of America, about October, 1919, to invoke the Pittman Act; sell silver dollars out of the Treasury as bullion; and so keep down the premium on silver, stabilize the exchanges, and conserve gold and the gold standard. The leader in this movement was the Hon. George E. Roberts, noted gold-standard director of the Mint under Presidents McKinley and Roosevelt (1898-1907 and 1910-1914); and since then administrative vice-president of the great National City Bank of New York. The subsidiary International Banking Corporation later played the stellar role in buying and using the dollars consigned to China. The venerable Mr. Roberts pointed out that there were 69,513,660 fine oz. of theoretic silver contents in the 89,876,246 dollar pieces still available to sell within the limit of amount authorized by the Pittman Law. There was a further 218,269,513 coins with 168,817,850 oz. still in the Treasury. It nearly equaled a whole year's production from the world's mines. Mr. Roberts proposed to amend the Pittman Law to sell, and later replace *all*. He said:

"The present seems an opportune time to dispose of all the remaining silver dollars, and Congress might well enlarge the authority of the Secretary of the Treasury to enable him to do this. If . . . the Secretary shall repurchase the silver by purchasing bullion at $1 an ounce, it would create a still larger reserve market at that price, affording a *very important guaranty of stability to the silver producing industry, besides rendering a world service by stabilizing the exchanges in the present emergency*" (from the leading article, "Is the American Silver Dollar Headed for the Melting Pot?" appearing early in November, 1919, in the November issue of "The Americas," published by the National City Bank; italics mine).

Negotiations between, on the one hand, Mr. Roberts and other bankers, and, on the other side the Treasury, were followed Nov. 10, 1919, by the acceptance by the Treasury of Mr. Roberts' proposal to invoke the Pittman Act, except that Mr. Roberts' proposed amendment was not immediately seconded "at this time." The following inspired announcement appears in the *Boston News Bureau* of Nov. 12, 1919:

"The government is not contemplating any legislation at this time to meet rising price of silver, *but expects to handle the situation under the Pittman Act. An official of the Treasury Department said: 'The Pittman Act contains ample authority for dealing with any situation which may arise.'*" (Italics mine.)

Another noted banker to invoke the Pittman Act was Vice-President Lane of the Guaranty Trust Co. of New York (and subsidiary Asia Banking Corporation, which later participated). Mr. Lane had broached as an alternative suggestion the use of certain powers of the Federal Reserve Board granted under the 1917 war-time Trading Acts to regulate the exchanges and control the price and export of silver by stringent export licenses. Both Mr. Lane and the Treasury rejected any definitive price "fixing," any interference with export, and any interference with exchanges, and favored merely to "stabilize" the market by sales under the Pittman Act of silver dollars as bullion.

By the Nov. 10, 1919, plan, our Treasury silver dollars were to be sold as bullion for use in China, dollar for dollar, payable in *any* lawful money. The price meant 1.29\frac{3}{16}$ per fine oz. The sales would be conditional, of course, provided that silver should be boosted by the crisis and maintained materially above that level. It had not yet reached that price. The coins were to be melted by the purchaser banks here or in China before their re-sale in China as bullion. Four different laws constitute the banks proper agents of the Secretary of the Treasury in this business.

The melting agreement was put in writing Dec. 6, 1919, as also an agreement to give the government half the profits, more strictly amended in the government's favor Dec. 8. As the profit-guarantee clause constituted sale of the dollars at more than $1 each, something which the Secretary of the Treasury is barred from doing under the Parity Act of 1900, the contract was made with the Federal Reserve Board as "dummy" or clerk for the Secretary, as it also functioned in the India transaction. The reason for using the silver in China was because India was not in the market; war-time prohibition of private import still ruled in India; and in China and Hongkong were the greatest dislocations of the commercial exchanges and demand for silver.

In the week prior to Nov. 10, silver was stabilized at $1.23 and a fraction. On Nov. 10, it passed $1.27. It first passed 1.29\frac{3}{16}$ on Nov. 20. It kept on climbing. The price was never again under $1.29 till mid-March, 1920, despite tremendous dumpings by the U. S. Treasury (63,000,000 oz. in three months) and other nations. On or about Nov. 25, 1919, the first 3,000,000 silver dollar pieces were released out of the San Francisco Mint and Sub-Treasury vaults. That day silver sold at 1.37\frac{1}{2}$ New York. The silver was released at the last hour for shipment for China on the "Pearl Shell" out of San Francisco that day, and the "Empress of Russia" out of Vancouver the next day. On the west coast that day $1.43 was paid for silver to catch the steamers. A further $9,000,000 was similarly released the first week in December to catch the steamer "Nanking" out of San Francisco about Dec. 10, bound for China with one of the greatest cargoes of silver coin and silver bullion in the history of silver.

The purchasers of these and all the later dollars shipped to China were the International Banking Corporation and the Asia Banking Corporation, already mentioned, and the Park-Union Foreign Banking Corporation, the China branch of the Irving National Bank group of New York. Shipments from Dec. 18 were monopolized by this trio by an agreement with the government (via the Federal Reserve Board) dated Dec. 6, amended Dec. 8, 1919, and calling on the first order for up to $20,000,000. Other banks participated in the

earlier purchases and shipments—the Equitable Trust Company of New York, and the two British Asiatic banks, the Hongkong and Shanghai and the Chartered Bank. Heavy consignments to China went out in December and January in addition to those already mentioned.

A sale of 50,000,000 silver dollar pieces to the New York Federal Reserve Bank, Feb. 27, 1920, was for use in China, like the other sales, but an easement in the crisis resulted so that they never had to be shipped nor destroyed and are still existant with us. Indeed, they remained in custody of the government in the Assay Office and Sub-Treasury vaults at New York, though title had passed to the bank, under a special agreement to reserve the coins for China use, the bank having meanwhile transferred to the government a credit of $50,000,000 on its books as full payment. The gold reserves of the bank were below the legal minimum, and the sale served another peculiar purpose under the Pittman Act in restoring the gold reserve to the legal requirement. The legal reserve had to be 35 per cent gold and legal tenders against deposits, plus 40 per cent minimum gold against note circulation. For the week ending Feb. 20, the bank had been compelled to report only 40 per cent gold against notes and 33.9 per cent against deposits. For the week ending Feb. 27, the report would show only 31 per cent. The sudden sale Feb. 27 of those 50,000,000 silver dollar pieces, served that day to restore the legal minimum to the requisite 35 per cent (35.2) against deposits and 40 per cent against note circulation. The crisis was passed and the reserve has been maintained ever since, by a safe, substantial margin. Nor must it be assumed that this constituted padding out the "gold reserves" with "cheap" silver dollars. The silver dollar was worth *more* than the gold dollar. The opening words of the Pittman Act define it (its official title) as "An Act to conserve the gold supply of the United States." The transaction of Feb. 27 served memorably in that crisis in conserving the gold reserves and gold supply of the United States.

Coins to the amount of $30,793,529 were sold out of the Treasury for export, and were exported, unmelted, on that movement, according to Acting Secretary Gilbert (page 258, Senate Commission reports, July, 1923). Another corrected U. S. Treasury figure cites $31,951,487 total such coins exported abroad, whether sold out of the Treasury or otherwise, and including meltings here before export, and of which $1,058,892 came back unmelted in July-September, 1920, leaving $30,892,595 net sales, exported and destroyed so far as the U. S. Treasury is concerned.

A total of $29,587,703 is admitted in "registered" China and Hongkong customs returns to have reached there, unmelted; and of which 1,281,237 were re-exported or consigned back to us in mid-1920. The balance absorbed $28,306,466, and was there melted and destroyed by the purchaser banks, which are lawfully qualified to act as agents for the Secretary of the Treasury under the Pittman Law. There seems no tenable doubt that this known *minimum* amount, which was both sold out of the Treasury as bullion *and* properly melted, must be repurchased. It remains to get officially itemized records of sales out of the Treasury, payment received, and record of the actual melting of the silver.

C. L. BREGER.

New York.

The Promoter and the Prospector

THE EDITOR:

Sir—This old burro scout and rock hound would like to pass a few remarks on Mr. X's article published in your journal on August 18, 1923, on page 269 ("Blue-sky" Laws). Mr. X wants his story solved for the reason that we have so many stupid lawmakers in our law factories. Solution, educate the people. The government is as good as the people that make it, and not one fraction better. As for letting mine promoters run wild, I say no!

I will not put on record at present the places or names of any facts I know to be true. I have seen $1,500,000 blown in on one property; then the whole shebang was sold for junk. The manager was a former circus clown. On another property $70,000 was spent, and in this case there was no junk left to peddle. The manager was a former mule skinner. One thing for certain: he was an artist in skinning the public.

Now this example and several more show where the stockholders' money evaporates. The cure? When the British Government officials discovered that rinderpest was destroying cattle in Africa, they knew that it would kill a profitable business, so they engaged an expert doctor, who conquered the evil, and today Africa is safe for cattle.

When Mr. Stockholder finances or grubstakes and sees his $100 spent $2 underground and $98 in office fixtures he is like a Missouri mule: he is going to balk. Can you blame him for not pulling the whole load, with no oats in sight? As for money wasted for pleasure that Mr. X writes about, this habit is nothing new. Read your Bible about Mrs. Queen of Sheba, who loaded her camels with gold and silver, and then traveled far to visit King Solomon. We are told that King Solomon gave this lady many presents. It seems to me that some of these mine promoters are trying to give the public some of old King Solomon's medicine.

We the prospectors and miners want to see the people have a fair show for their money. Allow a dirt digger to take charge of the wheel of a battle ship and he will run her on the rocks and the crew will drown. The same condition applies to prospecting and mine promoting or running the United States Government.

If your bad dog bites the public you are compelled to put a muzzle on him, and when mine promoters run wild, I say make laws to safeguard your pocketbook!

Kingman, Ariz. E. B. FOSTER.

Weight of Steel Balls

THE EDITOR:

Sir—In the *Journal-Press* of Aug. 4, on page 197, an article appeared in which the writer states that he has never seen the correct weight of steel balls for ball mills in print. If he will examine Vol. 61, page 276, of the *Transactions* of the American Institute of Mining and Metallurgical Engineers he will find this weight correctly given. E. W. DAVIS.

Minneapolis, Minn.

[The statement to which Mr. Davis refers is as follows: "If the balls are made of steel weighing 500 lb. per cu.ft., and are all of one size, it may be shown that the charge will weigh 74.05 per cent of 500 lb. or 370.25 lb. per cu.ft. . . . The factor . . . 65 per cent is probably more nearly correct." (Space being limited and the balls not being of one size). "Using this factor, the charge would weigh 325 lb. per cu.ft."—The Editor.]

Consultation

Timber on Mining Claims in Forest Reserves

"Your consultation page brings out some interesting questions and their answers, and it occurs to me that you might be able to answer a question with which I am now confronted.

"Who owns the timber on a patented mining claim located in a forest reserve? I am informed that timber on a patented lode claim in a United States Forest Reserve belongs to the government, and not to the owner of the claim, and is even subject to sale to other parties who may bid for it. The ranger's attention was called to the fact that a patent grants surface rights within the boundaries of a claim, as well as the right to follow the veins apexing thereon, and his answer was that a patent did not grant that which was above the surface, meaning the timber. I know of an instance where at the present time an owner of a patented mining claim is cutting timber from that claim and paying the Forest Service for the timber. The claim was located and patented before the United States Forest Service came into existence."

From our own experience in the field, in mining lands located in the Forest Reserve, we are led to believe that the owner of a patented mining claim is entitled to all the timber growing upon it and does not have to pay any fee to the government for hewing it. We recall cutting a right of way through a National Forest for a long-distance transmission line with the permission of the Forest Service. For the timber cut down on patented land we paid the owner; for that on forest land we paid the government.

In order to procure an authoritative summary of the law involved in this case we have asked the Hon. J. W. Thompson to give us his opinion. Judge Thompson states that:

1. A patented mining claim or any known mineral lands cannot be included in a mineral reserve in the sense that the claim or mineral lands become thereby a part of the reserve.

2. A patent to a mining claim conveys the absolute title to the land and to all that is *thereon, therein, or thereunder or above*—from the center of the earth to the sky above the earth!

3. The Forest Service make no claim to timber on a patented mining claim lying within the boundaries of a reservation.

As a matter of record the following citations and annotations are given. They cover this case and may help to make similar ones clear:

Under the Act of March 3, 1891 (26 Stat. 1093, p. 1103), the President is authorized to make forest reservations on the public lands.

This act was supplemented by the more specific Act of June 4, 1897 (30 Stat. 11, pp. 35, 36), and the former Act was to be administered in accordance with the provisions of the later Act.

Persons are permitted to enter upon such forest reservations for prospecting, locating and development of the mineral resources.

Any mineral lands within any such reservation shall continue to be subject to location and entry as such.

The Act does not authorize the inclusion therein of lands more valuable for minerals contained therein than for forest purposes.

And if mineral lands are included in a forest reservation, they may be restored to the public domain.

United States v. Levenson, 206 Fed. 755;
Yard, In re. 38 Land Dec. 59.

By an Act of Feb. 20, 1896 (29 Stat. 11), certain forest reservations in Colorado were opened to the location of mining claims, and existing mining claims within any of the reservations were validated.

Owners of mining locations were expressly permitted to "fell and remove from such mining claims any timber growing thereon, for actual mining purposes."

Under the Act of Oct. 1, 1890 (26 Stat. 650), creating certain forest reservations in the State of California, it was held that a miner on a mining claim within a reservation was restricted from cutting timber on any lands therein outside of his own claim.

Yosemite National Park, In re. 25 Land Dec. 48.

Timber cutting is permitted on unpatented mining claims for the working of such claims or for the support of improvements.

Act of March 4, 1909, 35 Stat. 1088.

Effect of a Patent

A patent is the perfection and consummation of the title conveyed by the previous location.

Silver Bow Min. Co. v. Clark, 5 Mont. 378;
Tyee Consol. Min. Co. v. Langstedt, 1 Alaska 439.

A patent to a mining claim is a quit claim deed from the United States, and when properly recorded is notice to the world of all it contains.

McCarthy, In re. 14 Land, Dec. 105.

When a patent for a mining location is issued it covers everything embraced in the lands to which no prior rights have attached.

Pacific Coast Min. Co. v. Spargo, 16 Fed. 348.

A patent conveying the legal title must prevail over all other claims.

Richmond Min. Co. v. Rose, 114 U. S. 576.

On the issue of a patent for a mining claim the legal title passes from the United States.

United States v. Marshall Min. Co., 129 U. S. 579.

When a patent to a mining claim issues the title passes from the government and no person can question such title who has not prior thereto by compliance with conditions prescribed by some statute, himself acquired an interest in the claim.

Wight v. Dubois, 21 Fed. 693.

A patentee of a mining claim cannot be deprived of all benefits arising from his patent.

Carson City Gold Min. Co. v. North Star Min. Co., 73 Fed. 597.

A patent to a land is a deed of the government.

U. S. v. Mullan, 10 Fed. 785.

A patent is an instrument by which the government passes its title.

Hayner v. Stanley, 13 Fed. 217.
Redfield v. Parks, 132 U. S. 239.

A patent is the higest evidence of title and is conclusive against the government and all claiming under junior patents or titles.

U. S. v. Stone, —— ——

A patent is an instrument by which the fee simple title to a mining claim is granted.

Creed, etc., Min. Co. v. Uinta Tunnel Min., etc., Co., 196, U. S. 337.

A patent to land of which the Department has jurisdiction, is both the judgment of that tribunal and a conveyance of the legal title to the land.

Le Marshall v. Tee Garden, 133 Fed. 826.

The question of the validity conclusiveness effect and inviolability of a patent was eternally foreclosed in the celebrated Southern Pacific Railroad case.

Burke v. Southern Pacific Ry. Co. 234 U. S. 669.

Recent Technical Publications

Reviews, Abstracts, and References

Three Valuable Reference Works

The Mineral Industry During 1922. Vol. 31. Edited by G. A. Roush. McGraw-Hill Book Co., New York. Price $12.

Ten days earlier than last year, the new volume of the "Mineral Industry" has just made its appearance. The same manner of presentation is adhered to as in previous volumes, and the number of pages is again about 900. There are chapters on all the more important metals and non-metallic minerals, including coal and coke, in most instances written by experts who have added much information from private sources to a compilation of published matter. All of the more important technical articles that have appeared are abstracted and bibliographies are appended. The scope is international, though the most space, of course, is given to activities within the United States. Robert H. Richards and Charles E. Locke again have written an excellent chapter on ore-dressing and coal-washing progress.

We take this opportunity of suggesting that possessors of the 1921 or 1922 editions of this book correct the value of the Indian rupee given in the table of the value of foreign coins in the initial pages. The rupee is now worth 0.486 of the U. S. gold dollar, and there are 10 rupees to the pound sterling, instead of 15, as stated. The change in the value made three years ago has evidently been overlooked by the revisers.

Like the preceding volumes, the last edition of "Mineral Industry" is a most excellent reference book and even a good supplementary textbook of current technical progress. It covers somewhat the same ground as "Mineral Resources," published by the U. S. Geological Survey, but appears much more promptly.

Kent's Mechanical Engineers' Handbook. Tenth edition. Edited by Robert T. Kent. John Wiley & Sons, New York. Price $7 in genuine leather; $6 in Atholeather.

When we bought our first copy of Kent, some fifteen years ago, it was called a pocketbook; now an extra half inch has been added to its thickness and it is more appropriately named a handbook. It has always been our favorite reference book for all kinds of engineering information, and this latest edition seems to be much more up to date than most revisions of similar books. There has been wholesale revision of the chapters on materials, non-ferrous metals and alloys, heat, fuels and combustion, the steam boiler, railroad engineering, electrical engineering, and machine design especially. For the first time considerable data is presented on aeronautics, automobiles, heat insulation, reinforced concrete and safety engineering.

The worth and the shortcomings of a book of this kind can only be discovered through long-continued use. There are always some things that are not properly indexed and some statements that are ill-advised. About the only way that such things can be corrected is for users of the book to report the matter to the editor or publishers. All in all, this volume contains a mass of practical engineering data, for all other technical men as well as mechanical engineers, attractively presented, well bound, and sold at a reasonable price.

The Engineering Index, 1922. Published by the American Society of Mechanical Engineers, 29 West 39th St., New York. Price $6.

Like its predecessors, this volume is an annotated index of the more important articles that have appeared in the engineering press of the world during the time covered in the compilation, in this case the last few months of 1921 and the year 1922. About half of the items refer to papers that appeared in periodicals published outside of the United States. The references are not confined to mechanical engineering subjects.

E. H. ROBIE.

Guniting Wet Shafts—"Guniting in the Athens Mine Shaft" is the title of a 10-page paper published by the Lake Superior Mining Institute, copies of which can be obtained from the secretary, A. J. Yungbluth, Ishpeming, Mich. The shaft was very wet and it was necessary to give it an impervious lining to make the ventilation system work. Details of the procedure that was followed are given.

Metal Statistics—The annual statement of metal statistics has just been published by the Metallgesellschaft, Frankfurt am Main, Germany. As usual, the data given includes production, consumption, imports, exports, and prices of aluminum, lead, copper, nickel, quicksilver, silver, zinc, and tin, for the world and for the most important countries.

Chihuahua Labor Law—An English edition of the Labor Law decreed by the twenty-ninth legislature of the State of Chihuahua, Mexico, has been published as an 83-page booklet which may be obtained for $1 from Camara Nacional de Mineria del Estado de Chihuahua, Apartado 49, Chihuahua, Chih., Mexico.

Fires in Metal Mines—Suggestions for the prevention of fires in metal mines, well arranged for practical application, are given in an illustrated 15-page bulletin of the Lake Superior Mining Institute, entitled "Fire Prevention and Fire Fighting in Metal Mines." Obtainable from the secretary of the institute, A. J. Yungbluth, Ishpeming, Mich.

Mineral Resources—Recent bulletins of the "Mineral Resources" series, published by and obtainable on request from the U. S. Geological Survey, Washington, D. C., include: "Fluorspar and Cryolite in 1922," 8 pages; "Graphite in 1922," 6 pages; "Strontium in 1922," 3 pages; "Fuller's Earth in 1922," 3 pages; "Arsenic in 1922," 26 pages; "Quicksilver in 1922," 12 pages; and "Magnesium and Its Compounds in 1922," 18 pages.

Nickel Ores—The Imperial Institute has published an 81-page bulletin on "Nickel Ores," which discusses their occurrences, character, and uses. Like the others of the series, the scope of the book is worldwide, and a bibliography of the more important articles that have appeared on the subject is given. Copies of the booklet may be obtained for 5 shillings from John Murray, 50A Albemarle St., London, W. 1, England.

South African Mining—The annual reports of the Secretary for Mines and Industries, and the Government Mining Engineer, for 1922 are now available from the Government Printer, Box 373, Pretoria, South Africa. The bulletin gives a complete statistical record of mining in South Africa for the year under review. The price is 10s. 6d.

New Patents

Tin Smelting—No. 1,461,957. July 17, 1923. H. H. Alexander, Westfield, N. J., assignor to American Smelting & Refining Co., New York. Tin ores are treated in a blast furnace with suitable material to form silicates of tin, which are removed as a slag.

Tube Milling—No. 1,461,977. July 17, 1923. S. E. T. Ewing and J. L. Willey, Johannesburg, Transvaal. Ore in large and angular fragments is supplied to a tube mill as regular mill feed, and as the fragments become rounded they are removed, broken, and returned to the mill.

Petroleum—No. 1,462,288. July 17, 1923. W. J. Knox, New York, assignor in part to A. R. Speer, Bronxville, N. Y. Heated liquid is discharged into an oil well to raise the temperature of the oil-bearing stratum sufficiently high to reduce the viscosity of the oil therein, and thereby increasing production.

Flotation Machine—No. 1,463,405. July 31, 1923. J. P. Ruth, Jr., Denver, Colo. A flotation machine with an impeller through the shaft of which air is drawn to be subsequently mixed with the ore pulp by emission through the blades of the impeller. Additional aëration is given by introducing compressed air through a porous mat placed at the inner wall of the settling compartment and comparatively near the surface of the pulp.

Electromagnetic Separation — No. 1,463,713. July 31, 1923. W. M. Mordey, Westminster, England. Finely divided mineral matter is separated by passing it longitudinally over a relatively long and narrow support arranged adjacent to the poles of an alternating current multiphase electromagnet.

SOCIETIES, ADDRESSES, AND REPORTS

Pan-Pacific Congress Discusses Hygiene and Sanitation

Sessions at Melbourne Devoted Largely to Consideration of Health and General Welfare Measures

The Pan-Pacific Congress opened in Melbourne, Australia, on Aug. 13 and concluded its sessions on Aug. 20. Dr. R. R. Sayers, of the Bureau of Mines, Washington, was sectional chairman of the hygiene section. Another noted American visitor was Dr. A. J. Lanza, who is temporarily associated with the Commonwealth of Australia Health Commission. Dr. Sayers' address dealt with coal-mine sanitation. His subject was divided into three parts—1, drinking water; 2, sewage disposal; and 3, ventilation.

Dr. Watkins Pitchford, of the Miners' Phthisis Medical Bureau, Johannesburg, South Africa, read a valuable and interesting paper on silicosis and gave facts and statistics and an account of the treatment of the disease on the Rand. He illustrated his address with lantern slides, which explained all the conditions under which the men worked in the mines. His subject was divided into two parts—1, silicosis without additional infection, and 2, silicosis with tuberculosis.

Dan Harrington contributed a paper on metal-mine ventilation, with special reference to the use of flexible canvas tubing. In this he showed that it was extremely easy to conduct air to dead ends and ventilate efficiently those working places.

E. W. Chinnery, of Papua, discussed the health of the native miners in the New Guinea copper mines. He quoted government regulations as to diet and the housing of the natives.

A. A. Atkinson, chief inspector of coal mines in New South Wales, contributed a paper on the ventilation, hygiene, and accidents in coal mines. It is interesting to learn that the death rate of coal miners between the ages of twenty-five and fifty-five in New South Wales was lower than the average death rate for those ages. The chief ailments contracted were bronchitis after the age of sixty-five and nystagmus due to the low illumination, contracted after many years' employment.

Dr. W. C. Sweet spoke on the subject of the hookworm disease—ankylostomiasis—in the Australian mines. There is no endemic hookworm in the metal mines of Australia. The Newcastle coal mines are slightly infected, but the Burrum and Ipswich coal mines, of Queensland, are highly infected. Methods of overcoming the disease were recommended, the chief being proper sanitation.

P. H. Warren, hygiene officer of the Broken Hill South mine, gave an interesting dissertation on ventilation and dust control in metal mines with respect to the work carried out at the Broken Hill. Speaking first about dust control, he showed the many means which were employed at the South Mine for preventing the formation of dust at its source by the use of sprays, water drills, appliances for drills not supplied with a central water inlet, and atomizers. He then described the way the amount of dust in mine air was calculated, with the konimeter and other apparatus, and stated that the mine air had been successfully kept within the limit of 5 mg. of dust to the cubic meter. Then dealing with temperature he showed how the Kata thermometer was used effectively in determining the suitability of working places for satisfactory work. The ordinary wet bulb thermometer was not good enough, although regulations have been enforced on its readings. In all probability the work done in ventilation and dust control at the Broken Hill South Mine is more advanced than in any other mining field of the world.

Stevens Institute Raising Funds

The Stevens Institute of Technology million dollar endowment campaign was given impetus at a meeting held Sept. 27 at the Engineers' Club in New York under the direction of John W. Lieb, vice-president of the New York Edison Co., who is in charge of the campaign in Manhattan. Plans for raising the New York quota for the fund were perfected following an address by Alfred Rutgers Whitney, Jr., president and treasurer of the Whitney Company. Mr. Whitney is a member of the national executive committee for the fund.

Study of Metallography Making Rapid Gains

Metallography, according to Prof. E. O. Harder, of the University of Minnesota, in a paper on metallurgical education at the recent convention of the American Society for Steel Treating at Pittsburgh, is only given 2.62 per cent of the time at sixteen colleges in this country; or, by including certain courses at one school, a total of 3.26 per cent. There are at present 2,500 metallographic laboratories in the United States, but few of the operators therein were trained in our schools; therefore the courses should be increased for this growing study of metals. The gain in the number of such laboratories has been rather remarkable, there being 240 in 1912; 400 in 1916; 900 in 1918; and 2,500 in 1923.

British Mining Engineers Plan Conference and Federation

Acting on the recommendation of their respective councils, the British Institution of Mining and Metallurgy and the Institution of Mining Engineers have decided to call an "Empire Mining and Metallurgical Congress." The assembly will be held in London during the first week of June, 1924, in connection with the British Empire Exhibition. At that meeting it is hoped to establish a permanent "Empire Council of Mining and Metallurgical Engineering Institutions." The intention is to link together in this form of federation the sister institutions within the empire, by means of which matters affecting the general welfare of the mineral industries may be dealt with in a fully representative manner. It is pointed out that there is no question of amalgamation or of interference with the internal affairs of the institutions involved. Each will retain its entire autonomy.

The Prince of Wales has consented to be the honorary president of the forthcoming congress. The following institutions have joined with the Institution of Mining and Metallurgy and the Institution of Mining Engineers in the effort to make the mining congress a success: The Institution of Petroleum Technologists, the Iron and Steel Institute, the Institute of Metals, and the National Federation of Iron and Steel Manufacturers.

Though the tentative program for the conference has not been completed, one of the features of the meeting will be an address on "Mineral Resources and Their Relation to the Prosperity and the Development of the Empire," by Lord Long.

Zinc Institute and A.I.M.E. to Meet in Joplin

A joint meeting of the American Zinc Institute and the St. Louis Section of the A.I.M.E. will be held at Joplin, Mo., Oct. 22 and 23, at the Connor Hotel. The program, like that of last year, will be a blending of serious discussions of vital subjects, visits to the important mines and mills of the district, and good fellowship. The tentative program is as follows: Oct. 22: Informal breakfast, Connor Hotel; luncheon-meeting, Tri-State District Club House, Picher, noon; visit to mines en route to Miami, where a dinner has been arranged and the guests will remain over night. Oct. 23: Return to Joplin for luncheon at Connor Hotel and joint meeting in the afternoon; informal dinner in the evening.

MEN YOU SHOULD KNOW ABOUT

Courtenay De Kalb is at the Roadside mine, near Tucson, Ariz.

C. N. Bell is representative of the Metals Exploration Company in Colorado.

J. K. Turner has returned to Goldfield from an extended trip into California and Arizona.

Milnor Roberts has recently made examination of mining properties at Cornucopia, Ore.

Roscoe H. Channing, Jr., president of the United Comstock Mines Co., has been in Virginia City.

H. C. Dudley is visiting the Ahumada lead mines, in the Erupcion district of Chihuahua, Mexico.

A. S. Winther is manager of the United Comstock Mines Co.'s operations at Cold Hill, Nev.

H. C. Boydell has gone east after completing a geological study of the Richmond Eureka mine, at Eureka, Nev.

Dr. W. L. McDougald, of Montreal, has resigned from the board of directors of the British Empire Steel Corporation.

Theodore Marvin, mining engineer, has joined the editorial staff of *The Explosives Engineer*, at Wilmington, Del.

Frederick Bradshaw, general manager of the Tonopah Belmont Development Co., has been in Reno from San Francisco.

G. Chester Brown has been appointed to the position of chief mining engineer of the Industrial Accident Commission of California.

W. C. Hill, petroleum economist, of the U. S. Bureau of Mines, spent September in California visiting the various oil fields of the state.

Frederick C. Fearing, mining engineer, of New York City, is making a field study of glaciation in the Lafayette National Park, in Maine.

N. O. Lawton, mining engineer of Salt Lake City, is examining mining properties near Phoenix, Ariz. He expects to be in New York City about Nov. 1.

Rene Engel has resigned his position as mining engineer for the Anaconda Copper Mining Co. to accept the chair of geology at the Oklahoma School of Mines.

Robert E. Dye, of Cobalt, latterly consulting engineer of the Keeley mine, South Lorrain, has been appointed manager of the Vipond Consolidated, of Porcupine.

Herman Gunter, State Geologist of Florida, is preparing a report on the clays of Florida, especially the ball clays or kaolins and the common brick-making clays.

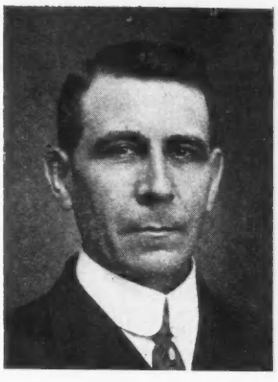
D. J. Kennedy, superintendent of the Bingo Gold Mines, at Herb Lake, Manitoba, recently received his degree as mining engineer from the Board of Examiners at Winnipeg.

J. B. Headley, formerly field geologist with the Western Petroleum Exploration Co., Great Falls, Mont., is now doing student graduate work in geology for Yale University.

Woolsey McA. Johnson, formerly of Hartford, Conn., is now doing work on bio-chemistry at Argus, Bucks County, Pa., at the Masters' Inn., under Dr. E. B. Weissberg, of Philadelphia.

Dr. S. M. Tory, president of the University of Alberta, has been appointed chairman of the Research Council of Canada, to succeed **Dr. Frank D. Adams**, who recently resigned that position.

R. W. Ellis, State Geologist of New Mexico, with the co-operation of David S. Hill, president of the State University, has prepared a report on the present status of oil and gas development in that state.



R. W. Ellis

E. P. Beaudin has been appointed general manager of the East Butte Copper Mining Co., succeeding the late Oscar Rohn. **P. F. Minister** has been made assistant general manager.

J. H. Warner, who has been consulting engineer and geologist for the East Butte Copper Mining Co. for fifteen years, is now chief geologist and consulting engineer of that company.

James F. Parmelee has joined the Worthington Pump and Machinery Corporation organization as sales engineer in the foreign department, his headquarters for the present being in New York.

S. F. Shaw has been appointed consulting engineer to the Cia. Minera San Marcos and the Cia. Minera La Perlita, both situated in the Mazapil district, Zacatecas, Mexico.

Samuel Coghlan sailed on the steamship "Essequibo" for Chile on Oct. 13 to take up his duties as assistant smelter superintendent for the Braden Copper Co. Mrs. Coghlan accompanied him.

Dr. George Otis Smith, the director of the U. S. Geological Survey, addressed the Boston section of the American Institute of Mining and Metallurgical Engineers on Oct. 16 on "Lessons From the Coal Commission's Work."

A. H. Brooks, Dr. T. Wayland Vaughan, Dr. N. M. Fenneman and **Dr. H. E. Gregory**, who represented the U. S. Government officially at the scientific conference recently held in Australia, have returned to the United States.

Morton Webber was recently appointed consulting engineer of the Minas Pedrazzini Gold & Silver Mining Co. A new operating staff will be installed under Mr. Webber's direction. The Minas Pedrazzini control the famous Las Chispas silver mine and other silver properties in Sonora, Mexico.

General William Black and **Colonel Stewart**, of Washington, D. C., government engineers, are making a trip of inspection of Texas state waterways. Escorted by **Major B. B. Browne**, acting engineer, with headquarters at Galveston, they examined the intracoastal canal and connections with the sulphur mines at Freeport and Gulf.

G. E. Danielson, recently engineer with the Sullivan Machinery Co. at Birmingham, Ala., has been transferred to Lima, Peru, and promoted to have general charge of the company's business in Peru, Chili, Ecuador, and Bolivia. Mr. Danielson is a graduate of the University of Colorado and of the Massachusetts Institute of Technology.

Byron Wilson, of Los Angeles, and **George H. Shepherd**, of Vancouver, B. C., have just returned from a three months' prospecting and mineralogical survey of the Whitewater, Eldorado, Taylor Basin, and Bridge River districts of the interior of British Columbia, on behalf of the Trites, Wood & Wilson interests. A complete assay outfit accompanied the expedition, by pack train.

M. R. Walker, a mining engineer of Pittsburgh, has been appointed special expert in charge of the non-ferrous division of the metals section of the U. S. Tariff Commission. Mr. Walker received his degree in mining engineering from the Michigan College of Mines. He had seven years of active engineering experience in Mexican mines and for four years was chief engineer of the Cerro de Pasco company in Peru. In addition he has had experience in Bolivia and Argentina.

MEETINGS

The American Iron and Steel Institute will hold its twenty-fourth general meeting at the Hotel Commodore, New York City, on Thursday, Oct. 25, 1923. Following the banquet at the Commodore on the evening of the 25th, a special train will be run to Aberdeen, Md., and on Friday, Oct. 26, the institute will hold a joint meeting with the Army Ordnance Association, at the U. S. Army proving grounds at Aberdeen.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary of the Week

NEW YORK can be made the dominant silver market of the world, in the opinion of Senator T. L. Oddie. The Senator points out that China purchased two-thirds and India one-half of its silver in the United States in 1922.

The Kansas Exploration Co. and the Kanok Metals Co. have each started the erection of a mill in the Joplin-Miami district.

Recent statistics indicate that the current production of copper is from 10 to 15 per cent in excess of consumption.

The silver-mining industry of northern Ontario is healthy in spite of the decline in production at Cobalt.

The Anaconda company has put its zinc concentrator on a three-shift basis of operation in order to handle Butte & Superior ore.

The Chief Consolidated Mining Co., after years of experiment, has decided to build a mill at its mines in the Tintic district, Utah.

The White Caps Mining Co., having overcome its metallurgical difficulties, hopes to operate its Nevada property at a profit.

The Treadwell Yukon company will construct a concentrating plant in its mine at Keno Hill. This is probably the first installation of a complete underground mill.

George Wingfield and associates have given a bond on the Dolly Varden mine and railroad in British Columbia to New York capitalists.

The Peñoles company has opened good lead-silver ore in the Socorro mine, in the Durango district, Mexico.

The first zinc letter boxes have been installed by the Post Office Department in New York City.

Mazapil Copper Co.'s Operations in Mexico Curtailed by Strike

Small Properties Busy — Numerous Mines Ship; Others Are Developing

In the Mazapil district in Zacatecas, Mexico, a strike of smeltermen and miners at the Concepcion del Oro smelter and at the Aranzazu mines is curtailing operations. Both are properties of the Mazapil Copper Co.

The Providencia mine of the Peñoles Mining Co. is making a large production of lead-silver ore. J. M. Brooks is superintendent.

Shaft sinking is continuing at the Alicante mine, and at the Nazareno mine unwatering operations are in progress; at the latter property a large orebody of silver-lead-zinc sulphides will be extracted for shipment to the Monterey smelter. W. W. Shelby is superintendent.

The Bonanza unit of the American Smelting & Refining Co. is in full operation. H. Steiger is superintendent.

Development work and production of ore is being carried on at the San Marcos mine. Rafael I. Vazquez is in charge.

Operations on a small scale are being carried on at the Perlita mine, at Concepcion del Oro.

The Rucio mine has been leased from the Mazapil Copper Co. by Isgrig, Harrison & Lomeli, and operations on a small scale are being undertaken.

Anaconda Zinc Concentrator Will Go on Three-Shift Basis

ACCORDING to L. V. Bender, general manager of the Washoe plant of the Anaconda Copper Mining Co., the zinc unit of the reduction works will go on a twenty-four-hour basis as soon as the Butte & Superior company begins shipment of zinc ore, which will be about Nov. 1. The additional tonnage will require approximately twenty additional employees. The zinc plant is now operating only eight hours per day.

A. S. & R. Wants to Market "Contract" Copper Independently

Permission to sell independent of the Copper Export Association copper which it is marketing on contract for smaller producers who are not members of the association has been asked of the association by the American Smelting & Refining Co. No action on the request has been taken.

Through officials the A. S. & R. is said to have expressed its desire to continue as a member of the association, but feels that its hands should not be tied in the matter of disposing of copper through contract for small companies.

Alaska Juneau Realized $37,000 Operating Profit in September

Plan to Mine 10,000 Tons Daily Soon—Family Men Come to Mines

Operations at the Alaska Juneau Gold Mining Co., in Alaska, for September are summarized as follows: Tons of ore trammed, 198,000; coarse tailing rejected from mill, 101,000 tons; tons fine milled, 97,000. The gold, lead, and silver recovered amounted to $134,000, or $1.38 per ton milled ($0.68 per ton trammed). Operating costs were $97,000, or $1 per ton milled ($0.49 per ton trammed). The Juneau operating profit amounted $37,000 for the month; the estimated profit for the month was $11,500 after deducting from the Juneau operating profit $8,000 on capital account, $14,500 interest on indebtedness and $3,000 for taxes, insurance, and miscellaneous expense.

At present, 402 men are employed. It is anticipated that 450 men will be employed when the daily tonnage trammed reaches 10,000 tons. During the summer months Alaska Juneau had difficulty in securing men and as a consequence the tonnage handled diminished. It is probable that this condition will not be repeated in another year, as more men of family are joining the company's force and their homes in Juneau are being repaired for permanent occupancy. They are coming to stay.

Overproduction of Copper Indicated by Statistics

September Shipments Lowest of the Third Quarter, the Total Being 160,000,000 Lb., Against Refinery Production of 200,000,000 Lb. —Six Weeks' Supply on Hand

UNOFFICIAL statistics for September show that stocks of copper increased about 40,000,000 lb. during the month. Shipments, both foreign and domestic, totaled 160,000,000 lb., whereas the refinery production was about 200,000,0000 lb. The corresponding average monthly figures for the third quarter are 167,000,000 and 190,000,000 lb., so that a current overproduction of around 14 per cent is indicated.

The figures show that the increase in stocks was due largely to decrease in domestic shipments; though there was a decline in foreign shipments, it was smaller in proportion. Foreign shipments in September were 67,000,000 lb., or 42 per cent of the whole, compared with approximately 80,000,000 lb., 40 per cent of the whole, in August. Domestic shipments approximated 93,000,000 in September, compared with 125,000,000 lb. in August. In July foreign shipments were about 65,000,000 lb. and domestic shipments 102,500,000. Foreign shipments for the third quarter consequently showed appreciable improvement over those of the first half, averaging about 70,000,000 lb. a month for the third quarter, compared with an average of around 63,000,000 lb. a month for the first half and 64,000,000 for the first nine months of 1923. Just why there was so great a decline in September shipments compared with August is a matter of speculation.

Shipments, foreign and domestic, for the first nine months of 1923 averaged approximately 189,000,000 lb. a month, a peace-time record. Average shipments during the first quarter were 200,000,000, during the second 190,000,000 and during the third 167,000,000. During each successive quarter foreign shipments showed improvement, but decline in domestic rate was unfortunately more rapid than increase in foreign shipments.

It is believed in many quarters that the decline in domestic shipments in September does not jibe with the actual rate of current consumption; that domestic consumers are actually using around 110,000,000 lb. per month, or 85 per cent of the maximum of last spring. If 70,000,000 lb., the average foreign absorption for the third quarter, be added, the total monthly shipments would be about 180,000,000, or within about 10 per cent of the estimated current rate of production. What will happen both as to production and consumption during the winter remains to be seen. The stock on hand as of Oct. 1, was 250,000,000 lb., compared with 210,000,000 lb. Sept. 1, or six weeks' supply at the September rate of shipment.

Houghton Will Have Fine New Metallurgical Building

Plans and specifications for the new metallurgy building to be built at the Michigan College of Mines, at Houghton, Mich., have been received by the college authorities from the state architect. The former building was destroyed by a serious fire about a year ago.

The new structure will be considerably larger than the old building. It will have a frontage of 155 ft. and a depth of 114 ft. to the end of the wings. It will be of brick and steel construction, three stories in height, including the basement floor, with two wings two stories high.

In the mill room and the crushing rooms, the floors are to be of plastic material, so that foundations of machines can be altered at small expense if necessary to move them. All machinery is to be provided with individual motor drives.

Entrance to the building will be on the first floor, where offices and wet laboratories will be located. From this floor the balconies of the mill and furnace rooms will be reached. The wet laboratories will be so situated that men working in the mill or furnace rooms will have easy access to them. A large auditorium will be the feature of the second floor.

Ferry Appoints Silver Export Association Committee

W. Mont Ferry, chairman of the committee on organization of the proposed silver export association, has announced twelve of the fifteen members of the committee: C. F. Kelley, president Anaconda Copper Mining Co.; Charles Bocking, general manager Butte & Superior Mining Co.; F. H. Brownell, vice-president American Smelting & Refining Co.; Fred Carroll, vice-president and general manager Atlas Mining & Milling Co., Ouray, Colo.; Stanly A. Easton, general manager, Bunker Hill & Sullivan Mining & Concentrating Co.; John Hays Hammond; Alfred Harrell, president California Rand Silver, Inc.; Dr. S. A. Holder, president Asia Banking Corporation; J. G. Kirchen, manager Tonopah Extension Mining Co.; E. J. Raddatz, president Tintic Standard Mining Co.; F. Y. Robertson, vice-president United States Smelting, Refining & Mining Co., and Robert E. Tally, general manager United Verde Mining Co.

Hilltop Nevada Quits

The Hilltop Nevada mine, situated at Hilltop, about 15 miles from Battle Mountain, has been closed. The mill was shut down several months ago, but mine work was continued in the hope that development would be warranted.

Premier Gold Dividends $4,450,000; Last $400,000

THE Premier Gold Mining Co. declared a dividend of $400,000 for the three months ended Sept. 30. This brings the total dividends to date to $4,450,000. It is a little curious considering the success of the concern that the few shares on the market seem to find few bidders at more than $2.50 per share of $1 par value. The last quotation on the Victoria exchange was $2.25 bid and $2.75 asked.

White Caps Operations in Nevada May Show Profit

Manhattan Gold Property Has Had Difficulties—Roaster Will Be Relined

The recent statement to stockholders in the White Caps Mining Co. operating at Manhattan, Nev., is hopeful. At one time it looked as if the White Caps was destined to become a large and profitable producer of gold, and ore reserves were generally believed to be large and rich. Real troubles began after the mill was built. The ore proved to be exceedingly difficult to treat, and during early operations most of the contained gold was lost. In addition, ore reserves shrunk appreciably with development, due to the irregular character of orebodies.

It was found necessary to assess the stockholders in order to continue operations and to attempt to solve the complex metallurgical problems in order to make a satisfactory extraction. In all, thirteen assessments have been levied, and while there is no certainty that there will not be more, the recent statement shows that operations for May, June, and July gave a gross production of $79,687.16 and a net profit of $6,350. Operations for August gave gross production of $21,959.24 and net loss of $2,172.82. The reason for loss in August is stated to be reduced roaster capacity, resulting in loss in extraction, due to poor condition of lining. About two weeks will be required to reline the roaster, and during that time all milling operations will have to be suspended.

The average grade of the ore milled during the first four months of the fiscal year is given as $16.46 per ton. No figures are given regarding ore reserves, as the nature of the orebodies is not such that any accurate estimate can be made. However, mine conditions are said to be satisfactory, and when the new roaster lining is completed the inference is that mill tonnage, of the same grade as formerly, will be increased and extraction improved. This should mean profitable operation of the property.

John G. Kirchen, of the Tonopah Extension Mining Co., is at the head of the White Caps company.

Look for Increase in Ontario's Silver Output

Production for Half Year Surpasses 1922 Figure—Railroad Planned from Cobalt to South Lorrain—Active Prospecting

Special Correspondence

SO MUCH is being written every day about the gold mines of northern Ontario that the silver-mining districts get only incidental attention. Nevertheless, silver mining is far from comatose.

The Ontario Government has given orders to proceed with the survey of a branch railway line from Cobalt to the South Lorrain district. This does not necessarily mean that the line will be built, although it is fully expected that this will be done. Government officials are much impressed with the progress being made in the South Lorrain district, and it is altogether probable that the line will be constructed. This branch would provide satisfactory transportation to the Gillies Limit, as well as to South Lorrain, and would permit the milling ores of the latter district to be brought to Cobalt mills for treatment.

During the last few months there has been a big revival of interest in silver mining, and districts which have been lying dormant for years are again commanding attention. This is probably due to the remarkable results obtained at the Keeley and Mining Corporation properties in South Lorrain, and as a consequence not only is there a good deal of activity in South Lorrain itself, but interest is spreading to the Gillies Limit and the Elk Lake districts. During the past two or three years there has been a much greater knowledge and appreciation of the importance of geology in its relation to the silver deposits of this country. As a consequence, large blocks of ground have been taken up in the Gillies Limit and the Elk Lake district by responsible mining companies, and a really serious effort will now be made to carry on exploration on a scientific basis.

During the month of September the Nipissing mined ore of an estimated net value of $172,000, and shipped bullion of an estimated net value of $130,000. The low-grade mill treated 6,358 tons, and the high-grade plant 131 tons. The refinery shipped 201,209 oz. of bullion. The Colonial mine has started shipments of mill ore to the Mining Corporation concentrator. It is understood that the Mining Corporation will soon let a contract to sink a shaft on its holdings in the Gillies Limit. This shaft will probably be sunk to the contact, which is at depth of approximately 400 ft.

New construction at the Keeley mill is practically completed, and in about two weeks the tonnage will be raised from 80 tons a day to 140 tons a day. The company has over $100,000 worth of high-grade ore stored underground.

Banks in Cobalt report that there is more business and more accounts being opened than in any time during the past several years. The government figures for the first six months of the present year show an increase of 160,000 oz. in production over the same period as last year. Though there will, no doubt, be a decrease in production from individual mines, it is believed that this decrease will be offset by the production from South Lorrain and from Gowganda, where the Castle will soon have a mill in operation. If some of the other work in outside districts proves to be successful, it is quite probable that the silver output of the province will not only be maintained, but will be increased.

Kansas Exploration and Kanok Metals Start Mill Construction

Each Plant Will Have Capacity of 250 Tons per Shift—Three Shafts Will Feed First

The Kansas Exploration Co., which has done more drilling in the Joplin-Miami field than possibly any other organization, has at length taken steps looking toward actual production. It is beginning the construction of a modern concentrator on the Jarret land, immediately north of the Webber lease of the Commerce Mining & Royalty Co.

Shaft sinking on this lease was started by the company last February, and it has put this shaft down to the 320 level. Another shaft was started soon after the first one was begun, and still a third was started by the company a little later, this latter shaft being on the Foley land, to the east of the Jarret property. Some exceptionally good ore has been opened up, it is understood.

The mill, which is to be thoroughly modern and of a capacity of approximately 250 tons in ten hours, should be ready for operation in two months. It is expected here that the Kansas Exploration Co. will be one of the largest producers in the field within the next few years.

The Kanok Metals Co. is building a new concentrator on its Plum lease, near Century, Okla. It is an eighty-acre tract, adjoining the Underwriters No. 4 on the south, and the mill is being erected a short distance to the east of the No. 4 Underwriters mill. It will have a capacity of about 250 tons per shift, similar to other mills of which A. M. Gaines, of Joplin, is manager.

Alleges Wrongful Forfeiture of Mining Claims

The McLean Gold Mines, Ltd., is bringing an action for damages in the Supreme Court of Ontario against the provincial government on account of the alleged forfeiture of the title to mining claims in Temiskaming district and has also brought suit against the Porcupine-Paymaster, Ltd., claiming damages for trespass.

Silver City, Idaho, May Soon "Stage a Come-back"

Old Camp Rouses From the Lethargy of Fifty Years—Twenty-five Mile Haul to Railroad—Two New Mills Finished

The old camp of Silver City, discovered in 1866, with an authentic production of over $40,000,000 in gold and silver, is more active now than for many years. The district is in Owyhee County, in the southwest part of Idaho. Many of the old veins, such as the Ida Elmore, Golden Chariot, Poorman, and others, had rich ore, carrying free gold on the surface, and tellurides below to a depth of 1,500 ft. The mines have been idle and abandoned for many decades, but work on the extensions or some of the parallel vein systems has proved that there still may be profitable mines in the old camp. The veins of the district have not been large, but are true fissures in granite, running from 1 to 3 ft. in width. Granite is the predominating formation; it has been capped by flows of rhyolite and basaltic rocks.

Intrusive dikes cut the formation. The veins cut all the flows, although most of the ore occurs in the granite. Rich ore occurs frequently along lines of cross fissuring and sometimes in veins only a few feet distant and parallel in general direction to the course of the main ore channel.

The Neversweat Mining Co., Reginald Leonard, manager, is increasing its surface plant by the erection of a two-story bunk house to accommodate 40 men, an enlarged boarding house and a mill. A rod mill is used as grinding equipment. It is expected these improvements will be completed by the first of the next year, and in the meantime, drifting on the oreshoot is disclosing ore that is being sacked for shipment to smelters. This property is on the southerly extension of some of the early-day producers.

The Great Western Mines Co., of which T. W. Galligher is manager, has the northern extension of the Golden Chariot vein and is doing careful exploration work.

The Red Jacket Gold Mining Co. has a 15-ton mill about ready to run on a property south of the Cumberland, that has been undergoing new development for two years.

John B. Platts has a bond on the Mountain Chief, owned by James Murray since 1888. Considerable tonnage of $9 to $30 free milling gold ore is blocked out in the various tunnels, with ore ranging from 1 to 3 ft. in width. Platts expects to be able to get a mill on the property early next year. The vein resembles the parallel vein on the old Ida Elmore.

E. P. Kellogg has taken an option on the Village Blacksmith property and is getting out a shipment of ore to go to the smelter. As the camp is only 25 miles from the Oregon Short Line railroad at Murphy, $40 ore will stand shipment when mined in quantity and at reasonable cost.

Chief Consolidated, in Utah, Will Build Mill

Process Developed for Treatment of Complex Low-Grade Ores—Will Sell Treasury Stock

Announcement has been made by Walter Fitch, Sr., president of the Chief Consolidated Mining Co., operating at Eureka, Utah, that his company will build a mill for the treatment of such ores as are too low grade to ship and have not hitherto been amenable to milling. This will make available large tonnages of ore. Also, the company plans to expand its limestone operations by manufacturing hydrated lime. For many years the company has been making experiments with a view to the development of a suitable milling process, and it is now announced that an economical and profitable method of treatment has been found. Patents have been applied for, and some have been already received. To finance the new metallurgical plant, treasury stock amounting to 110,000 shares is offered at $3 a share. Preferred right of purchase will be given to stockholders of record Oct. 20, 1923.

Mr. Fitch, in discussing the company's policy, stated that it has always been the aim to perpetuate the enterprise. The cost of the company's property, Mr. Fitch said, together with the cost of the equipment for the operation of the mines is: Mining claims, $1,962,405; machinery, buildings, and equipment, $422,918; shares in subsidiary companies, $533,909; balance due from subsidiary companies for development work, $186,924; making a total of $3,106,158. All of these expenditures have been made out of the profits, and in addition $2,500,000 has been paid in dividends and $700,000 is held in the treasury. There is no standing debt, except the contingent one to the government, and no increase of capital liability, which will stand at less than $900,000.

In reference to the contingent debt to the government, Mr. Fitch stated that it was a claim for more than the company paid during the war, and that the company's counsel believed that all had been paid that was demanded under a fair construction of the law. However, because of the existence of the claim, the directors did not feel justified in using the money now in the treasury for mill construction.

Plenty of Jobs — Such as They Are — for Mining Graduates

Announcement has just been made by the mining engineering department of the University of Illinois at Urbana that eight of its graduates last June have been placed in good positions through the co-operation of the department. Among them are: J. Comstock, of Neoga, head assayer, United Comstock Mines Co., in Nevada; P. N. Ferguson, of De Kalb, mining engineer, Pacific Metals Corporation, Colombia, South America; R. S. Sanford, of Urbana, chief surveyor and assayer, Colombian Gold Mining Corporation, South America; E. F. Carpenter, of Williston, N. D., first assistant assayer, Tomboy Gold Mines Co., Telluride, Colo.; H. Jessing, of Dwight, chief assayer, Tomboy Gold Mines Co., Telluride, Colo.; A. B. Stevens, of Columbus, Ind., assayer, Inspiration Copper Co., Miami, Ariz. All men of the June class now have desirable positions. Salaries for these men range from $125 to $250 per month. The department had more call for mining engineers than it could fill, according to A. E. Drucker, assistant professor of mining. He believes that a mining engineering education offers wide opportunity for a young man.

Uncle Sam Tries Making Letter Boxes of Zinc

New York City's first zinc letter box has been installed at the corner of Maiden Lane and Front St. This zinc letter box is one of a large number which are being placed by the Post Office Department along the Atlantic Coast. The idea originated in the mind of a zinc miner in the Joplin-Miami district. Noting the rapid deterioration of the familiar green painted letter box, even at inland points, and probably having in mind the efficiency of zinc in use as roofing, he suggested to his employer that the letter boxes be made of sheet zinc. The employer passed this suggestion along to the American Zinc Institute, with the result that the government has had a large number of these zinc letter boxes manufactured and is now installing them where the test will be the severest—along the seaboard.

Underground Concentrating Plant Planned by Treadwell Yukon

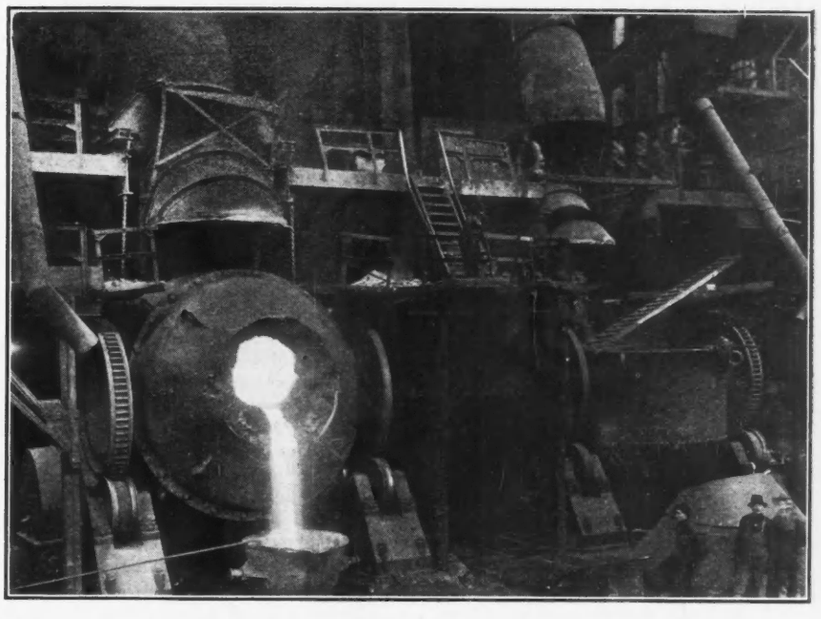
Novel Scheme for Mayo Property—A Total of 4,000 Tons of Ore Was Shipped This Season

What is probably the first underground mill and concentrator will be built by the Treadwell Yukon Co., F. W. Bradley's company that is mining silver-lead ore at Mayo, in the Yukon territory.

Tests are now being made at Kellogg, Idaho, upon the company's ores and plans will be prepared during the winter for a new plant. The reason for this novel situation is to provide "live water" for milling purposes and to avoid as much as possible the difficulties attendant upon the severe winter climate. It is anticipated that Diesel engines will be used for generating power.

The readjustment resulting from the proposed arrangement will favor transportation costs, as approximately equal freight tonnages will move in and out during the season. At present the preponderance of transportation is outward from the mine, and the costs are as a consequence excessive. Wages paid by the Treadwell company average $5.30 per shift. This plus board, which amounts to $2.73 per man-day, brings the labor cost to $8.03 per man per shift. There is plenty of available labor at the present time.

The company has shipped and delivered to the smelter at Kellogg, Idaho, 4 000 tons of silver-lead ore, the result of its mining campaign of last year. It is anticipated that 7,500 tons will be shipped during the next season. Active development is under way, with 70 men employed. The 300 level is being opened up and a drainage adit is being extended that will open up the vein on the 600 level.



Copper converters at the Trail plant of the Consolidated Mining & Smelting Co. in British Columbia

News from Washington

By PAUL WOOTON
Special Correspondent

"New York Can Be Made Dominant Silver Market"—Oddie

China Bought Two-thirds of Its Silver in the United States During 1922; India One-half—London Exercised—"Great Harm to British Trade," Says "Financial Times"

NEW YORK can be made the dominating silver market of the world if the interests concerned will cooperate to that end, declares Senator Oddie, chairman of the Senate Commission of Gold and Silver Inquiry, who probably will be chairman of the Senate Committee on Mines and Mining during the next session of Congress. Senator Oddie, in a recent statement, pointed out that in 1922 China "purchased 50,000,000 oz. of silver in America as against 22,000,000 oz. in London. Of the 46,000,000 oz. purchased by India in 1922, practically one-half was bought in America. The heavy purchases by China and India in New York thus far in 1923 indicate an increasing tendency to buy here rather than in London.

"The demand for silver in China," says Senator Oddie further, "frequently arises quickly. A high premium is paid for the early delivery of silver. It takes less time to make delivery from the United States than from London. This makes the American market much more attractive, and, in addition, there is the saving in interest on the metal in transit. The silver producers should be able to effect improvement which would make the New York market even more attractive to Oriental buyers. The maintenance of an open silver market in New York would afford a much-needed protection to American interests."

That the efforts of the silver producers in this hemisphere to take systematic steps to protect their own interests is occasioning concern in London may be judged from the following extracts from a recent issue of the *London Financial Times:*

"It is understood from private cables to this side that the legal difficulties standing in the way of an export association are greater than had been anticipated, and although it has been organized and certain promises were made at the Reno conference, it does not follow that Congress will readily pass any measure that will overrule the Sherman Law and other acts and give the association the necessary powers to control, and, presumably, enhance the price of silver in the United States. In fact, in some quarters the action of the 'Silver Senators' has been very pointedly criticised, and if the silver mining and smelting industry asks for what practically amounts to a subsidy for silver over a number of years it will meet with considerable opposition on its own ground before the plan can be put into effect.

"The new association claims to have the support of the leading silver producers, but so far nothing has been attempted in the way of dealing with the marketing of the metal. Various soundings, direct and indirect, have been made in the London market, but for the most part they have been received with marked coldness. London fixes the world's silver price daily, and while, of course, the business is in few hands, there is nothing to show that there is the slightest trace of anything like manipulation about the process of fixing the daily quotation. The number of orders held by the various banks and brokerage houses, and the extent of the supply, form the basis for the price movement; in other words, the law of supply and demand is allowed to operate without hindrance. This week, for instance, India has been a buyer, partly to cover, and this has offset selling by China; thus the price has been moving upward.

"If the matter of fixing the price were in the hands of American interests it is easy to see what would happen. India, as a large and important user of silver, would naturally be in favor of low prices, rather than artificially high rates, and if the price of silver were lifted to a fictitious level through American juggling, great harm would be done to British trade. If New York fixed its price above London parity a very complicated state of things would at once be in evidence; thus it is difficult to see how the Silver Export Association can hope to work without obtaining the co-operation of the leading London operators. The only weapon it would have would be the withholding of supplies, but, of course, new silver is not the only source of supply, and it would simply mean that a serious check would be given to the use of the metal, instead of the reverse. Substitutes could be very easily found for silver in directions other than subsidiary coinage, and at the moment the world has not the slightest use for silver as money. The Silver Export Association has thus a very difficult task before it, and if the leading London banking interests and brokerage houses maintain their present attitude it cannot possibly succeed. Silver is a world commodity, and any attempt to raise the price by manipulative measures would mean much to millions of British subjects all over the empire.

"The British silver houses have handled the silver trade of the world for many years, and they would not give up their valuable business without a struggle. The supply of silver outside new production and the metal secured from melted-down and old coinage alone would upset any such scheme, but this, added to the resistance that would have to be faced from the bullion brokers of London and the banks dealing in eastern exchange, would lift the task above the level of feasibility. At the same time, it is a very interesting departure, bearing in mind certain events which took place in connection with keeping India supplied with silver during the war."

Australia Needs Geologic and Topographic Mapping, Says Brooks

Mining Not Thriving in the Commonwealth—New Iron Ore Deposits Found — Oregon Fir for Mine Timber

Australia's outstanding need looking toward development of its mineral resources is geologic and topographic mapping, in the opinion of Alfred H. Brooks, of the U. S. Geological Survey, who has just returned to Washington after having attended the Pan-Pacific Scientific Congress, which held sessions at Melbourne and Sydney.

Under normal economic conditions, Australian mining men have little hope of entering the export market, as production costs are too high to compete successfully in world markets, chiefly on account of high wages for labor and restricted working hours. A 35-hour week prevails in the silver-lead fields under state law. With a market practically confined to domestic requirements, and with high costs, only the high-grade ores are being worked in Australia, the delegate found.

Depression in most of the metals as to price has caused a slackening of activity in recent months, Mr. Brooks found. Demand for steel for railroad use has revived, and this has caused increased activity in the iron-ore field of South Australia. The ore is transported to New South Wales, where the steel plants, of which there are two of major importance, are located close to coal. Recently, discovery of what appear to be rich iron deposits has been made in the extreme part of northwestern Australia, near tidewater, but development has not started.

Rich arsenic deposits are reported to exist in Queensland, but the visitors to the congress were given the impression that these were not expected to become an important factor in world supply, because of high production costs due to wages and hours of labor.

Gold mining is at a very low ebb in Australia. Placer mining has practically disappeared. The richest deposits have been worked out, and exploitation of low-grade ore is not profitable at present prices under the conditions faced by the operators.

Alaska Placer Mining Report Will Be Comprehensive

Field work by the Bureau of Mines has been completed in Alaska for the most comprehensive recent report on placer mining costs and methods. N. L. Wimmler, placer mining engineer, will be the author of the report which will appear as a printed bulletin. It will comprise about 300 printed pages in all probability.

Though it was impossible for Mr. Wimmler to visit personally the fifty placer mining centers in Alaska, arrangements have been made to secure detailed reports from operators in the centers which he could not visit. He conducted personal investigations, however, in the following districts: Nome, Solomon, Council, Ruby, Hot Springs, Rampart, Fairbanks, Upper Kuskokwim, Innoko, Iditarod, Yentna, Nizina, and Girdwood. The principal points to be covered by the report are: cost of mining; water supply; prospecting; thawing; open-cut mining; drift mining; hydraulic mining; dredging; sluices and gold saving; treatment and marketing; cost of supplies; labor; transportation; placer mining laws and taxation of mining property.

Athletic M. & S. Co. Scores in Freight-rate Case

The Athletic Mining & Smelting Co., of Fort Smith, Ark., apparently has won its traffic case in which it sought the benefits of lower rates on ores shipped to its plant. The Interstate Commerce Commission's examiner, who conducted the investigation of these rates, has recommended that the commission find the existing rates unreasonable and unduly prejudicial. Apparently he has established that the Miami Mineral Belt and Northeast Oklahoma railroads have been charging higher rates to the Athletic plant than for similar service to smelters in other territories.

News from Mining Districts

By Special Correspondents in the Field

Johannesburg Letter

Find Alluvial Diamonds Worth £62,802 —Gold Output for August Beats July

BY JOHN WATSON

Johannesburg, Sept. 11—A report on the property of the Transvaal Platinum, Ltd., has been prepared by Max Baumann. The company holds options over the whole or portions of nine farms in the Waterberg district on which the outcrop of the lode has been traced. The platinum is found in a lode formed on a fault plane in the felsite of the Bushveld complex, the red granite of the Bushveld running roughly parallel to and at some distance south of this fault plane. The width of the lode varies from a foot up to 30 ft. and its strike is roughly east and west, for a distance of about twenty miles. One piece of loose rock, containing visible metal, assayed platinum 107 oz. and iridium 43 oz. per ton. Twenty-six portions panned gave, from the concentrates, assay values varying from 144.5 dwt. down to traces.

I hear that developments on the Springs Mines (Far Eastern Rand) are of such an extremely satisfactory character that the plant, which has a capacity of 50,000 tons monthly, is to be increased gradually up to 120,000 tons per month. The mine has over five years' supply of ore reserves, on the present milling basis, and its value of 8.79 dwt. per ton will probably be found to have been increased by the latest discoveries.

The production of alluvial diamonds in the Transvaal during July totaled 10,451 carats, valued at £62,802. Out of 2,525 diggers working, 1,457 registered finds. The best outputs were at Grootdoorn's Farm, Bloemhof, where 164 diggers out of 199 working registered finds aggregating 1,581 carats, valued at £10,392, and at Kareepoort Farm, Wolstad, where 201 diggers out of 367 working registered 1,272 carats, worth £9,148.

The Transvaal gold output for August was declared yesterday by the Chamber of Mines at 769,371 fine ounces valued at £3,462,170. The realized price was 90s., or 9d. per ounce more than for July. The increase in quantity over July is 15,065 oz. and in value £96,079. New State Areas had an output of 10,877 oz., which is an increase of 6,338 oz. over the previous monthly output. The native labor returns for the month show an increase of 1,157 "boys" working on the gold mines.

The accompanying figures for August show details of the twelve most profitable gold mines:

Results of Gold Mine Operations on the Rand in August

	Tons Crushed	Value or Revenue, £	Working Costs Per Ton s.	Working Costs Per Ton d.	Estimated Profit. £
Government Areas	156,500	301,751	16	10.1	176,725
New Modder	116,000	240,791	16	5.4	145,364
Crown Mines	208,000	290,822	19	2.0	91,476
Modder B	67,500	140,455	19	4.2	75,153
Modder Deep	45,900	109,621	17	2.0	70,210
City Deep	101,000	184,300	22	7.5	70,033
Van Ryn Deep	64,800	126,560	18	11.0	66,065
Brakpan	71,000	120,245	20	11.8	51,312
Springs	55,700	109,166	22	10.5	50,697
Geduld	68,500	108,340	18	11.0	43,422
Randfontein Central	197,000	233,100	19	6.2	42,106
Robinson Deep	75,000	.....	17	8.6	36,728

London Letter

Welsh Tin Industry Busy — Maclaren Will Examine Plymouth Mine, in California

BY W. A. DOMAN

London, Oct. 4.—On the top of the announcement that the Government of the Federated Malay States has sold about 2,000 tons out of the 10,000 tons of tin held by it under the Badoeng Agreement, comes the news that a marked revival has taken place in the tin-plate industry. Partly owing to the Japanese disaster and partly to increased American enquiries, the Welsh tin-plate industry is being overwhelmed with orders; in fact, so much so that it has been decided to erect many new mills, which would seem to indicate that the trade revival is not regarded as of an ephemeral character. A working arrangement has been made between the Grovesend Steel & Tin-plate Co. and Richard Thomas & Co., the largest tin-plate makers in the world.

I hear that Dr. Malcolm Maclaren, geologist, who is connected with the National Mining, the Consolidated Gold Fields (South Africa) and Gold Fields American Development groups, is now on his way to California to inspect properties on behalf of Bewick, Moreing & Co., who are already interested in several Canadian undertakings in both the gold and silver districts. The main object of Dr. Maclaren's visit is to report on the old Plymouth Consolidated property in Amador County. This concern has paid fairly good dividends in the past, but finds it difficult to carry on mining and development work simultaneously. Should the report prove favorable, steps will be taken to find the necessary funds to embark on an extensive underground program.

Dr. E. T. Mellor, well known in mining and metallurgical circles, has recently examined the platinum finds in the Waterburg district of the Transvaal, and is stated to have reported favorably on the prospects. He is acting on behalf of the Central Mining and Rand Mines group, and it may be taken for granted that the new discovery will be thoroughly investigated.

The Wankie Colliery (Rhodesia) which supplies the Union Minière du Haut Katanga with 60,000 tons of coal and 96,000 tons of coke per annum, the mines of Southern Rhodesia with nearly 90,000 tons of coal, and the railways and other industries with about 150,000 tons of coal and 15,000 tons of coke, has found it necessary to enlarge its sphere of operations. New agreements have been entered into with the Rhodesia Railways and the Chartered Company (now a commercial and mining undertaking), and the capital is to be increased from £600,000 to £900,000. The shares are of the denomination of 10s., and under the reorganization shareholders are to receive 9d. in cash and three new fully paid shares for every two held. The excellent progress which the company has made is largely due to the ability of the general manager, A. R. Thomson.

MEXICO

Good Ore Found in Socorro Mine

Probably the most important recent development in Durango has been the discovery by the Peñoles Co. of a large body of silver-lead carbonate ore at the Socorro mine, near the old Vacas properties. This was an old mine full of waste. It had been worked many years ago, before the present railroad passed near the property, and the high-grade stringers gave ore rich enough to be shipped. An old miner upon examining the property looking for more high-grade streaks discovered that the rich streaks were really only a part of the vein or body of ore, and that the mine actually consisted of 20- to 50-ft. veins of low-grade lead and silver ores. The mine was cleaned out, and further development work done down to the 300 level. The Peñoles company then took the property over under lease and option, and is continuing the exploration work. At about the 500 level it is expected to find sulphide ores, and if the shoots already exposed continue below, an immense tonnage of good ore will result. The present ores average 200 gm. silver and 16 per cent lead.

The Vacas mines, only a short distance from the Socorro, were worked to about 800 ft. and were still in good ore when closed down; as the Socorro is in the same formation, limestone, it is expected that the orebodies will continue to great depth.

A curious incident was the discovery of a 50 ft. vein of 40 per cent manganese ore alongside of the other ores. This affords the necessary flux to make a complete smelting mixture from ores within the property boundaries.

Vacas Mine May Be Unwatered

Work continues on the Vacas mill, and though the original intention was to work up the large lead-zinc-silver dumps, estimated to contain 200,000 tons, it is also rumored that a lease will be taken on the old mines and they will be unwatered. This property was worked successfully by table concentration when the nearest railroad was forty miles away, and with a railroad only a few miles distant, it would seem that a much better result could be achieved now, especially with modern metallurgical processes.

The mines have not been worked for nearly twenty years. It is estimated that it will cost $100,000 to unwater and repair the old shafts and put the mines on a productive basis. It will take about $50,000 more to install a modern plant to go with the old mill and power plant that are at hand.

Silver-Copper Claims Will Be Developed

Mayo Thomas and associates have acquired the Borbon and Judia properties, situated in the Sierra Madre Mountains, 50 miles Southeast of Choix, Fuerte, Sinaloa, Mexico. The showing of silver and copper appears to warrant some prospecting to determine whether the properties are worth more extensive development.

German Krupps Seek Mexican Iron Mines, Is Report

RUMORS, with some basis in fact, say that the Krupp interests have been trying to obtain control of the Monterey Steel Works and the Iron Mountain, near Durango, Mexico. The officials of the Monterey Steel Co. have denied that control was about to pass into the hands of the Germans, but admit that the Krupp agent has been negotiating for the Iron Mountain. This admission lends more interest to the story than was at first given it, since is is evident that the possession of the iron ores at Durango would be of little interest except along with the Monterey plant.

ONTARIO

Will Prospect Edwards Ground

English interests have taken an option on the Edwards lot, which lies southwest of the Dome property in the Porcupine district, and are purchasing a mining plant, which will permit operations to be carried to a depth of 600 ft. There is a 50-ft. shaft on the vein, and the property was diamond drilled a few years ago by the Nipissing.

BRITISH COLUMBIA

Drum Lummon Bonded

Negotiations practically have been completed for the taking over of the Drum Lummon mine, at Hartley Bay, by a New York syndicate, which is represented by Edward L. Blimline. Operations at this mine were stopped in May of this year because the syndicate that had it under option could not carry out its agreement. About $90,000 had been spent on development and equipment, which included a tramway and wharf.

New York Interests Bond Dolly Varden From George Wingfield

GEORGE WINGFIELD and associates have given a bond on the Dolly Varden and Wolf mines, the railway, and all equipment to a New York syndicate. During 1920 and 1921 the Dolly Varden mine produced close to 900,000 oz. of silver from ore averaging in the neighborhood of 28 oz. per ton. In making this production the Taylor Mining Co., which owned the mine at that time, bent all its energies on production and paid practically no attention to development, with the result that it has been difficult to interest capital in the enterprise. The mine is well equipped with power and mining machinery, but needs a concentrator for its successful operation. The railway, which has not been operated since 1921, can be reconditioned at a reasonable cost.

UTAH

Increased Ore Shipments from Tintic and Park City

Shipments from Park City amounted to 2,674 tons for the week ended Oct. 6, compared with 3,110 tons for the week preceding. Shippers were Park City Mining & Smelting, 1,098 tons; Silver King Coalition, 1,002 tons; Park-Utah, 534 tons; Ontario, 40 tons.

Bingham shipped 78 cars, excluding shipments by the Utah Copper and Utah Consolidated. Shippers were United States Mining, 48 cars; Utah Apex, 22 cars; Bingham Mines, 5 cars; and Montana Bingham, 3 cars.

Shipments from Eureka for the week amounted to 127 cars, compared with 118 cars for the week preceding. Shippers were Chief Consolidated, 58 cars; Tintic Standard, 36 cars; Dragon, 9 cars; Victoria, 8 cars; Iron Blossom, 6 cars; Bullion Beck, 3 cars; Eagle & Blue Bell, 3 cars; Mammoth, 2 cars; American Star, 2 cars. The Chief Consolidated also shipped 9 cars of limestone.

CALIFORNIA

Mammoth Smelter to Restart

San Francisco Correspondence

According to local reports the Mammouth smelter at Kennett will probably resume smelting operations in November. This will add another mine to the copper producers, which now include the Mountain Copper Co., the Engels Copper Mining Co., the Walker Mining Co., and the Calaveras Copper Co. Several small copper mines are also operating. At the Mammoth and Balaklala mines and the smelter several hundred men are employed in repair work. This work is now nearing completion.

Ben Hur Divide Incorporates

Articles of incorporation of the Ben Hur Divide Mining Co., now reopening a property in the Grass Valley district, have been filed. The company is incorporated for $150,000.

Kennedy Will Have Fan

At the Kennedy mine, near Jackson, the foundations and concrete work for the installation of a ventilating fan have been completed and the fan is expected to be received soon. Fifty stamps are being operated, and more will be added as soon as suitable men can be found. The labor situation at this mine has improved, but uncertainty as to a supply of efficient labor still exists.

Alhambra May Have Mill

At the old Alhambra mine near Gardnerville, Nev., J. W. Hopkins, during the past year has opened the Alhambra vein for several hundred feet. Recent assays from a large oreshoot show values in gold and silver as high as $20 per ton. The vein varies from 12 to 20 ft. in thickness. The gold is found both free and associated with sulphides. It is expected that plans for the reduction plant will be ready in the near future.

No Five-Day Schedule for Michigan Mines

THE recent report—writes our Houghton correspondent—originating in the East, to the effect that leading copper producers would curtail production, the plan being to shut down from Friday night until Monday morning, has no bearing on the industry in the Michigan copper district.

The Michigan mines are down to almost the absolute minimum in metal output, due to labor shortage. Further curtailment would seriously increase per-pound costs. Generally, the mines are outputting at 50 to 55 per cent of the normal average of pre-war years. Only one, Ahmeek, is getting out full production, but Ahmeek is part of Calumet & Hecla Consolidated.

ARIZONA

Gold Dust Mill O. K.; United Oatman's Plant Progressing

Operation of the Gold Dust mine, in the Oatman district, was recently halted by a fire that disabled the hoist. The new mill is reported to be making a satisfactory recovery, and there is a large tonnage of ore on the dump at the mill that will assay $25 per ton. The ore is being mined from a 5-ft. vein that has been opened for a distance of 115 ft. A new mill is also being erected at the United Oatman Co.'s property with F. J. Snyder, of Tucson, in charge of the construction. Considerable leasing is being carried on in the Oatman district, where custom mills are available for treating the ore.

Verde Inspiration Construction Awaits Money

Plans have been announced for the erection of a cyanide plant at the Verde Inspiration mine, in the Cherry Creek district, south of Jerome. California capital has been interested, and it is planned that a mill that will treat about 60 tons per day will be erected. It is thought that the ore will change to copper at depth, but at present operations are to be directed to the gold ores. Part of the machinery for the mill is already on the ground, and it is expected that financing of the undertaking will be completed and the mine operation started within a short time.

Shattuck Ships Lead Ore

The Shattuck Arizona company, at Bisbee, has resumed the shipment of lead ores, due to the increase in price being paid for the metal. One car a day is now being shipped, but it is stated that about three cars would be shipped if good miners were available. About 150 men are employed at the Shattuck mine. Another body of good ore was recently opened on the 500 level, and stoping is being continued on the ore on the 600 level.

MONTANA

Contract Let for Jib Mill Equipment

The directors of the Jib Consolidated Mining Co., which controls several mines at Basin, Mont., have announced that a contract has been awarded to Horace J. Brown, of San Francisco, for the greater part of the equipment for its concentrator. The delivery will be made as soon as possible. The Anaconda Hardware Co. has also been awarded a contract for part of the equipment. The plans for the concentrator provide that the capacity of the original unit will be 300 tons.

Development work is being carried on at the Katie and Hope mines, and by the time the mill is ready to operate a large tonnage of ore will be ready. W. L. Creden has retired as general manager of the company and has been succeeded by B. F. Edwards.

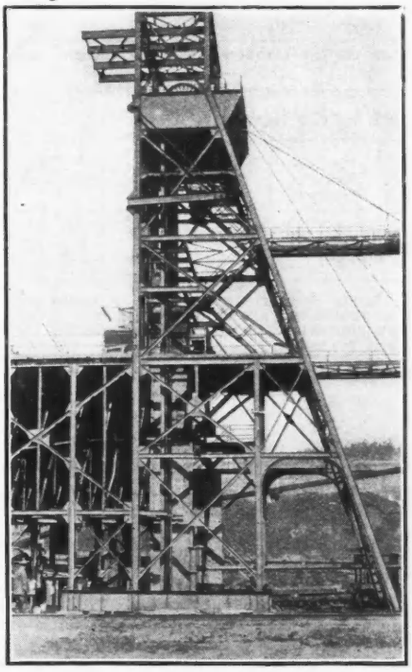
Expansion at Two Philipsburg Properties

The Moorlight Mining Co. has resumed mining operations at its manganese property, from which a high grade product has been shipped.

The Pocahontas Silver Leasing Co. has installed an additional two-drill compressor in preparation for the sinking of the main shaft. The company recently employed a small crew of men.

Ship Phosphate Rock

The Phosphate Products Co., of Philipsburg, is preparing to make its initial test shipment of 500 tons of phosphate to St. Louis. As far as known this will be the first phosphate to be shipped out of this district. If the material proves satisfactory, a good tonnage will be mined, as two large deposits are being developed.



Headframe at the Chapin mine at Iron Mountain, Mich.

New 600-Ton Zinc Concentrator Started Near Picher

THE Tulsa-Quapaw Mining Co. has completed and placed in operation a new mill in the Kansas field, just west of the Tar River mine, northwest of Picher, Okla. It is one of the largest mills in the Kansas field, having a capacity of 600 tons per ten-hour shift. Operations are being carried on at 236 ft., where good ore runs were shown by drilling operations, but the ground as yet is not thoroughly opened up. The latest improved milling machinery is being used at the property, and Chicago Pneumatic oil engines are used to furnish power, both for running mill and compressor. Cones and a Dorr thickener also are used. Charles A. Neal is manager.

NEVADA

Manhattan Consolidated Building Mill

The Manhattan Consolidated Mining Co. has started construction work on its new 50-ton mill. Mill foundations are being laid and machinery is already on the ground.

Goldfield Deep Mines Shaft Reaches 1,500 Ft.

The shaft of the Goldfield Deep Mines Co. is 1,500 ft. deep, all cement work has been completed, and fair progress in sinking is being made. The work has been delayed to some extent due to shortage of skilled shaft men. No water has been encountered and it is hoped that none will be found until after the 1,600 point is passed. At that depth a station will be cut and preparations made for pumping machinery, as it is certain that a large flow of water will be encountered within the next few hundred feet.

JOPLIN-MIAMI DISTRICT

Rialto Turns to Field Shaft

The Rialto Mining Co. has taken over the Winfield mill, south of Picher, and is operating it as the Rialto No. 2. A hopper and derrick has been installed at the west field shaft and an air drift is being cut connecting this shaft with the mill shaft. Two runs of ore have been worked at the mill shaft, one at 185 ft. and the other at 240 ft.

Mill Goes Up in Six Weeks

Indiana investors have completed a new mill on the C. M. Clark land, southwest of Baxter Springs, and have placed it in operation. The lease was obtained from H. O. Neff, of Joplin, about six weeks ago, and the construction of the mill was started immediately afterward. The mill shaft at present is down to only 220 ft. and will be sunk to the 235 level at once. Considerable drilling has been done on the lease, proving the existence of good orebodies.

THE MARKET REPORT

Daily Prices of Metals

Oct.	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
11	12.50	41.00	41.50	6.85	6.55	6.20
12	.....	.....	.....	....	.....	....
13	12.50	41.00	41.50	6.85	6.60	6.225
15	12.625	41.125	41.625	6.85	6.60	6.225@6.25
16	12.625	40.875	41.375	6.85	6.575	6.25@6.30
17	12.625	41.125	41.625	6.85	6.55	6.30@6.375
Av.	12.575	41.025	41.525	6.85	6.575	6.255

*These prices correspond to the following quotations for copper delivered: Oct. 11th and 13th, 12.75; 15th, 16th, and 17th, 12.875.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Oct.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
11	60½	61	63½	201½	199	26⅜	25⅝	32	31¾
12	60⅛	60⅞	64	201¼	199¼	26½	25¾	31⅞	31½
15	60⅝	61⅜	64	202⅜	200⅜	27	26¼	32⅝	31⅞
16	60⅝	61⅜	64	201¾	199⅞	27⅜	26⅜	33	32¼
17	60⅞	61⅝	64	202⅝	200½	27½	26½	33½	32½

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Oct.	Sterling Exchange "Checks"	Silver		Gold London	Oct.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
11	4.54⅞	63½	31½	90s 6d	15	4.52⅞	63¼	31 7/16	91s 1d
12	.....	...	31 5/16	90s 7d	16	4.53⅜	63¼	31⅜	91s 1d
13	4.53	63¼	31 7/16	.....	17	4.53	63¼	31⅜	91s 2d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Markets

New York, Oct. 17, 1923

A better feeling is noticeable in the copper, lead, and zinc markets, owing principally to the strength of the London prices. All three of these metals advanced during the week in the chief European market, which has helped to check the decline in copper, to increase the demand for American slab zinc abroad, and to remove the slightly softer tendency in the lead market noted last week. Interest in tin by domestic consumers is still at a low ebb.

Copper

Whether a definite turn for the better has taken place in the copper market is difficult to say. No doubt exists, however, that all the copper that was available on Thursday and Saturday at 12.75c. delivered has been either taken up or withdrawn from the market. Today the lowest price at which the metal sold was 12⅞c. delivered, with at least one producer asking 13c. Sales have been light, with only moderate tonnages bought. At the moment the tendency of the copper market is upward, but much depends upon the attitude of the London market, whether this tendency will continue. Several European consumers have been interested in the present market.

Production of copper in the United States continues at a high rate. It is hard to understand how some of the higher cost producers are able to withstand the stress of the low prices at which copper has been selling for many weeks, but they seem to keep the even tenor of a high rate of output without perturbation.

The copper market has been distinctly one for buyers, who cannot be blamed for postponing purchases in the face of a constantly declining price. Should the market come to a rest for a time at its present level, or rise from it, buying will probably be stimulated considerably.

Export business has not been very satisfactory during the last week.

Lead

The official contract price of the American Smelting & Refining Co. continues at 6.85c. New York, at which level it has been generally sold by other producers as well. We have a record of a small lot sold at 7c., New York, but not in tonnage enough to affect quotations. The St. Louis market declined slightly, so that the normal freight differential between the New York and St. Louis markets is becoming expressed in the prices quoted in those markets. Sales of lead were good. One producer, who found that he had on his hands a larger tonnage than anticipated, was an active seller early in the week, at which time the metal sold in the West as low as 6.50c. per lb. The advance in London and the withdrawal of this one producer from the market caused the price to rise, so that some sales were made at 6.60c. Today it is possible to obtain lead in St. Louis for 6.55c. The strong European demand for lead is having a healthy effect in the American markets. All Mexican lead bullion is going abroad; some Mexican lead in ores and concentrates which pay a lower duty is entering the United States. Supplies of lead from Spain are short, owing principally to labor disturbances and a disposition to use some of the production locally.

Zinc

The rise in the slab-zinc market has been one of the features of the metal markets. Yesterday and today the most pronounced advances were registered, carrying prices to at least 6.35c. with the tendency still upward. The demand for zinc from Europe is mainly responsible for the improved position

of the market. The statistics of the American Zinc Institute show that 8,167 tons were shipped for export during September. Production for that month was 39,105 tons; shipments (including exports) 42,683; stock on hand, Sept. 1, 26,471; on hand Sept. 30, 22,893. Export business played a very prominent part in the month's sales. Without it stocks would have shown an increase. The betterment in the London price is ascribed to the demand for slab zinc by British galvanizers, who have orders on their books sufficient to take care of operations for the remainder of the year. Some of the galvanized sheets and products are probably for Japanese consumption. The zinc-smelting companies view the improved slab-zinc market with satisfaction, as they have been having difficulty making both ends meet in the present ore market.

The price of high-grade zinc is 8¼ to 8⅜c., depending upon place of delivery. Demand for high-grade has been good.

Tin

A scarcity still exists of tin for near-by delivery, owing to the late arrival of vessels carrying the metal to American ports. Prices in the domestic market are lower than in London, so that there has been some bidding by London dealers for local supplies. Forward deliveries are quoted one-quarter cent less than spot.

Arrivals of tin, in long tons: Oct. 10th, Liverpool, 250; China, 10; 11th, Straits, 150; 15th, Liverpool, 300; Java, 150; Straits, 50; Australia, 5; 16th, Straits, 300; total so far in October, 2,770.

Foreign Exchange

No changes of importance occurred last week. On Tuesday, Oct. 16, cable quotations on francs were 6.045c.; and lire, 4.59c. Canadian dollars 1½ per cent discount.

Silver

The market has held steady of late on the strength of Indian bazaar orders, both in London and New York. China continues a seller in London, and this position is reflected in the local market by relatively low rates for San Francisco delivery.

Mexican Dollars—Oct. 11th, 48⅜; 13th, 48¼; 15th, 48¼; 16th, 48¼; 17th, 48¼.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade, 26@27c. per lb.; 98 per cent, 25@26c. London, £115 per long ton.

Antimony — Chinese and Japanese brands 7⅞c.@7¾c. W.C.C. brand, 8¼c. Cookson's "C" grade, 10.25@10.50c.

Bismuth—$2.55 per lb. London, 10s.

Cadmium—85c. per lb. London, 3s. 6d.

Cobalt—$3 per lb. for spot.

Iridium—$275@$300 per oz.

Nickel—27@32c. per lb. for 99 per cent virgin metal. London, £125@£135 long ton.

Palladium—$80 per oz.

Platinum—$116 per oz. London, £24 15s.@£25.

Quicksilver — $62 per 75-lb. flask. Quiet. San Francisco wires $61. London, £9 5s.

The prices of **Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Selenium, Tellurium, Thallium,** and **Tungsten** are unchanged from prices given Oct. 6.

Metallic Ores

Tungsten Ore—High-grade wolframite, $8.50@$9; high-grade scheelite, $9@$9.50 per unit. Ordinary grades, $8.25@$8.50.

Chrome, Iron Ore, Magnetite, Manganese, Molybdenum, Titanium, Vanadium, and **Zircon Ore** are unchanged from the quotations published Oct. 6.

Zinc and Lead Ore Markets

Joplin, Mo., Oct. 13.—Zinc blende, per ton, high $41.70; basis 60 per cent zinc, premium, $39; Prime Western, $38@$39; fines and slimes, $38@$36; average settling price, all zinc ores, $39.21.

Lead, high, $87.50; basis 80 per cent lead, $83@$84; average settling price, all lead ore, $83.60 per ton.

Shipments for the week: Blende, 12,933; lead, 1,788 tons. Value, all ores the week, $656,570.

This is the week producers were supposed to close the mills for the entire week, having announced that course to supersede the five-shift week. Estimates of mills in operation range from twenty-seven to thirty-seven. These are different counts by different persons. The output is variously estimated at 4,500 to 6,500 tons for the week.

Platteville, Wis., Oct. 13.—Blende, basis 60 per cent zinc, $41 per ton. Lead, basis 80 per cent lead, $85 per ton. Shipments for the week: Blende, 1,612 tons; lead, none. Shipments for the year: Blende, 25,326; lead 605 tons. Shipments for the week to separating plants, 1,111 tons blende.

Non-Metallic Minerals

Asbestos—Crude No. 1, $350@$500; No. 2, $250@$300; spinning fibers, $125@$150; magnesia and compressed sheet fibers, $75@$110; shingle stock, $50@$65; paper stock, $30@$40; cement stock, $17@$20; floats, $8@$12. All f.o.b. mines, per short ton, Quebec.

Barytes, Bauxite, Beryl, Borax, Chalk, China Clay, Diatomaceous Earth, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Graphite, Gypsum, Limestone, Magnesite, Manjak, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, Talc and Tripoli are unchanged from the Oct. 6 prices.

Mineral Products

Arsenious Oxide (white arsenic)—11c. per lb.

Copper Sulphate—4.90@5c. per lb., domestic product.

Potassium Sulphate, Sodium Nitrate, and Sodium Sulphate are unchanged from quotations of Oct. 6.

Ferro-Alloys

Ferromanganese — Domestic, 78@82 per cent, generally obtainable at $110 per gross ton, f.o.b. works. Spiegeleisen, 19@21 per cent, $45; 16@19 per cent, $44.

Ferrosilicon—50 per cent, $85.

Ferrotungsten—88@90c. per lb. of contained W, f.o.b. works.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrotitanium, Ferrouranium and **Ferrovanadium** are unchanged from the prices published Oct. 6.

Metal Products

Copper—Sheets, 20¼c. base; wire, 15¼c.

Lead Sheets—Cut, 10.50c.; full, 10.25c. per lb.

Nickel Silver—18 per cent Grade A sheets, 27½c.

Yellow Metal — **Dimension sheets,** 18½c.; rods, 15½c.

Zinc Sheets—Base price, $9.25 per 100 lb., f.o.b. plant.

Refractories

Bauxite Brick, Chrome Brick, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick and Zirkite are unchanged from the Oct. 6 prices.

The Iron Trade

Pittsburgh, Oct. 16, 1923

Production of steel ingots is now running at about 18 per cent under the peak rate, reached last April. Continuance of heavy production makes the steel outlook better than a month ago, since the conservatism everywhere exhibited makes it certain that the steel being shipped is required for actual consumption. Steel buying is widespread, but is of hand-to-mouth character except that a very good rail order book for the first half of next year is being accumulated. No little freight-car inquiry is coming out, but it is surmised that orders will not be placed until concessions are obtainable on the plates and other steel required.

Finished steel prices in general are rigidly maintained. Shading in black sheets for more than two months past has developed into a condition in which most of the smaller mills are quoting 3.75c., and the leading interest and some large independents maintain 3.85c. Galvanized sheets are being shaded a trifle.

Pig Iron—The market is quiet but steady, at last week's prices. A sale of 2,000 tons of foundry iron over fourth quarter helps to stabilize the price of $24, Valley. Bessemer is $25.50, Valley, and basic $24, Valley.

Connellsville Coke—Offerings exceed demand, which is light; heating coke, $3@$3.50; furnace coke, $3.75@$4; foundry coke, $5@$5.50.

COMPANY REPORTS

Kerr Lake Mines, Ltd.

Silver; Ontario

A report of the operations of the Kerr Lake Mines, Ltd., for the fiscal year ending Aug. 31, 1923, shows dividends paid totaling $300,000. Production totaled 8,268 oz. of silver in 4,076 lb. of high-grade ore.

Balance sheet as of Aug. 31, 1923, follows:

Assets

Kerr Lake Mining Co., Ltd., Shares acquired in consideration of the issue of capital stock of this company	$3,000,000.00	
Less amount received from Kerr Lake Mining Co., Ltd.	600,000.00	$2,400,000.00
Sundry investments at cost		90,879.57
Accounts and bills receivable		31,300.77
Investments in outside properties		
Tahoe Mine, Utah, 1,001,000 shares	435,185.74	
Rimu Gold Dredging Co., Ltd., New Zealand, 95,242 ordinary shares, $400,017.80; 11,006 preference shares, $37,982.26	437,999.06	
Wettlaufer Lorrain Silver Mines, Ltd., 147,000 shares	7,350.00	
Goldale Mines, Ltd., sundry expenses for which shares have been or are to be received	184,087.58	1,064,622.38
Cash		73,392.46
		$3,660,195.18

Liabilities

Capital stock		
600,000 shares at $4 each, fully paid		$2,400,000.00
Kerr Lake Mining Co., Ltd.		15,681.67
Sundry liabilities		1,000.00
Unclaimed dividends		4,122.35
Profit-and-loss account:		
Balance Aug. 31, 1922	$1,228,085.05	
Plus transfer from income and expenditure account	11,306.11	1,239,391.16
		$3,660,195.18

Income and expenditure account follows:

Administration and general expenses	$31,069.90
Sundry explorations and mine examinations	2,827.32
	$33,897.22
Dividends paid	300,000.00
Balance transferred to balance sheet	11,306.11
	$345,203.33
Dividends received from Kerr Lake Mining Co., Ltd.	325,000.00
Dividends received on preference shares of Rimu Gold Dredging Co., Ltd.	3,551.62
Interest	10,624.13
Profit on sale of securities	6,027.58
	$345,203.33

Operating account of Kerr Lake Mining Co., Ltd., for year ending Aug. 31, 1923, follows:

Expenses in connection with maintenance of mine, depreciation of plant, taxes and general administration	$29,665.09
Balance, being profit transferred to balance sheet	36,030.33
	$65,695.42
Ore on hand at smelters and in transit Aug. 31, 1923 (estimated)	$7,536.90
Less ore on hand Aug. 31, 1922 (estimated)	2,720.95
	$4,815.95
Profit on sale of securities	21,105.45
Interest and exchange	39,774.02
	$65,695.42

American Smelting & Refining Co.

A statement of the operations of the American Smelting & Refining Co. and its subsidiaries, for the first half of 1923 follows:

After deducting all bond interest, depreciation, ore depletion, taxes (including estimated federal taxes) and miscellaneous adjustments, there was a net income of $5,096,045.58, an increase of $3,270,122.20 over the same period for last year.

The balance sheet as of June 30, 1923, is as follows:

Assets

Property accounts	$124,911,106.38	
Investments	4,441,425.67	
Total capital assets		$129,352,532.05
Miscellaneous assets		
Prepaid expenses chargeable against future operations	$2,125,791.23	
Deferred accounts and notes receivable	98,844.79	
Inter-plant accounts in transit	48,914.78	
Current assets		
Total cash, and government securities	18,658,183.37	
Accounts and notes receivable	12,377,229.17	
Materials and supplies	6,778,148.29	
Metal stocks (not including metals treated on toll basis) less unearned treatment charges	39,145,523.01	
Cash and securities in funds	1,363,842.76	
Total current and miscellaneous assets		80,596,477.40
Total assets		$209,949,009.45

Liabilities

Bonds outstanding		
Am. Sm. & Ref. Co. Series "A" first mortgage bonds	$41,902,700.00	
Am. Sm. & Ref. Co., series "B" first mortgage bonds	9,850,000.00	
Preferred capital stock outstanding	50,000,000.00	
Common capital stock outstanding	60,998,000.00	
Total funded debt and capital stock		$162,750,700.00
Current accounts, drafts and wages payable	$13,884,093.29	
Interest on bonds		
Unclaimed	50,784.78	
Accrued, not due	671,533.75	
Dividends		
Unclaimed	76,752.76	
Payable after close of period	1,637,475.00	
Accrued taxes not due (federal taxes estimated)	2,986,987.17	
Miscellaneous suspended creditor accounts	2,176,877.72	
Total current and miscellaneous liabilities		21,484,504.47
Reserves		
Employees' pension	$1,275,064.06	
Employees' death benefit	622,196.22	
Metal stock	5,826,812.06	
Total reserve accounts	$7,724,072.34	
Profit-and-loss surplus	17,989,732.64	
Total profit-and-loss surplus and reserves		25,713,804.98
Total liabilities		$209,949,009.45

Summary of Consolidated Income and Profit-and-Loss Surplus Account

	Six Months Ended June 30, 1923	Six months Ended June 30, 1922
Net earnings of smelting and refining plants and industries immediately dependent thereon	$8,519,898.88	$5,216,128.17
Net earnings from mining properties	1,967,327.20	877,408.80
Total net earnings of operating properties	$10,487,226.08	$6,093,536.97
Other income—net	241,145.85	167,315.75
Net earnings, before deductions	$10,728,371.93	$6,260,852.72
Deduct		
General and administrative expenses	631,518.34	504,200.64
Research and examination expenses	71,279.41	26,495.77
Corporate taxes (including estimated federal taxes)	802,928.76	286,222.41
Total	$1,505,726.51	$816,918.82
Net income from current operations, before providing for bond interest, depreciation, obsolescence and depletion, but after providing for all taxes	9,222,645.42	5,443,933.90
Less interest on Am. Sm. & Ref. Co. 5 per cent first mortage bonds series "A" outstanding	$1,060,330.17	$865,925.74
Interest on Am. Sm. & Ref. Co. 6 per cent first mortgage bonds series "B" outstanding	85,985.34	.....
Interest on Rosita Coal & Coke Co. 6 per cent collateral trust bonds outstanding	.....	21,174.67
Depreciation and obsolescence	2,025,811.21	1,496,872.73
Ore depletion	881,734.45	728,952.16
Miscellaneous profit-and-loss adjustments	72,738.67	505,085.22
Total	$4,126,599.84	$3,618,010.52
Net income	$5,096,045.58	$1,825,923.38

Summary of Consolidated Profit-and-Loss Surplus Account

Balance at beginning of year	$15,438,543.07
Income for six months	5,096,045.58
	$20,534,588.65
Deduct dividends on	
Am. Sm. & Ref. Co. preferred stock	$1,750,000.00
Am. Sm. & Ref. Co. common stock	762,475.00
American Smelters Securities Co. preferred "A" stock	30,029.00
American Smelters Securities Co. preferred "B" stock	2,352.01
	$2,544,856.01
Balance June 30, 1923	$17,989,732.64

Benguet Consolidated Mining Co.

Gold; Philippine Islands

A report of operations of the Benguet Consolidated Mining Co. for the first six months of 1923 states that 27,542 tons of ore, of an average value of 38.76 pesos per ton, was treated. The gross value of gold and silver produced was 941,956.40 pesos. Balance sheet and profit-and-loss statement show a net profit of 434,542.01 pesos.

The following is a brief summary of receipts and expenditures:

	Pesos	Pesos
Receipts		
Bullion	941,956.40	
Exchange	928.50	
Store operation and interest	15,256.23	
		958,141.13
Expenditures		
Labor	148,406.64	
Supplies	131,430.53	
Taxes	37,398.28	
School and hospital	7,632.67	
Insurance	3,998.89	
Marketing bullion	9,071.67	
Mine miscellaneous	52,281.57	
Manila office	35,490.51	
		425,710.76
Gross profit		532,430.37
Less depreciation written off		86,746.26
		445,684.11
Less 2½ per cent bonus to general manager		11,142.10
Net profit		434,542.01

Balance sheet as of June 30, 1923, is given as follows:

		Pesos
Fixed assets		1,003,268.59
Working assets		429,150.77
Current assets		583,603.25
		2,016,022.61

Liabilities

		Pesos
Capital stock		
1,000,000 shares at 0.70 pesos each, fully paid		700,000.00
Current liabilities		78,458.26
Profit-and-loss account	Pesos	
Balance as at Jan. 1st, 1923	353,022.34	
Add profits for six months to June 30, 1923	445,684.11	
	798,706.45	
Less dividends paid	250,000.00	
Bonus to general manager	11,142.10	
	261,142.10	
		537,564.35
		2,016,022.61

Operation Account

	Pesos	Pesos
To operating expenses	321,063.54	
Taxes	36,090.61	
General expenses and marketing	64,692.32	
Fire insurance	3,540.65	
		425,387.02
Profit to profit-and-loss account		516,569.38
		941,956.40
By bullion		941,956.40

Profit-and-Loss Account

	Pesos
To depreciation written off	87,070.00
Net profit	445,684.11
	532,754.11
By profit from operation account	516,569.38
Exchange	928.50
Interest	4,056.38
Store operations	9,807.95
Rentals	1,391.90
	532,754.11

Facts for the Stockholder

XXVIII—Calumet & Arizona Mining Co.

The Calumet & Arizona Mining Co. was incorporated in Arizona, on March, 1901, as a successor to the Lake Superior & Western Development Co. From time to time it purchased properties of other companies, or acquired control through stock ownership. It bought the Copper Giant group, at Copper Creek, Graham County, Ariz., in 1908; The American Saginaw group in 1912; the Calumet & Bisbee group, and the Higgins group in 1913; the Calumet & Bisbee Development Co. in 1914; the Superior & Pittsburgh group in 1915; and the property of the 85 Mining Co., near Lordsburg, N. M., in 1920.

During 1914, the company exercised its option on treasury stock of the New Cornelia Copper Co., and now owns 1,229,741 shares, or 68.3 per cent of the stock of that company. In 1917, it secured an option on the stock of the Gadsden Copper Co., owning claims adjoining the United Verde Extension Mining Co. at Jerome, Ariz., and acquired 664,044 shares, but developments were not satisfactory and work was discontinued in 1920. In 1921, it secured an option on 1,000,000 shares of the Verde Central Mines, Inc., which is developing property in the Verde mining district, near Jerome, Ariz.

Property includes about 2,100 acres in the mineral zone of the Warren district, Arizona; 577 acres of the 85 Mining Co., near Lordsburg, N. M., and a 640-acre smelter site at Douglas, Ariz.

The Calumet & Arizona mines are in limestone, near a porphyry contact, and with porphyritic intrusions. Ore occurs in irregular bodies, and consists of copper oxides, sulphides, and carbonates, with native copper, and usually in an iron oxide or sulphide gangue. Much of the ore averages around 5 per cent copper, and carries 2 oz. silver and $1 gold. Ore reserves in 1916 were estimated at 1,976,000 tons, averaging 5 per cent copper, and 831,000 tons of 1.75 per cent copper and $1.25 in gold and silver. No recent estimates are available. Reserves of the New Cornelia property are estimated at 65,000,000 tons averaging 1.45 per cent copper.

The Bisbee property is opened by six main shafts, ranging in depth from 1,390 to 2,458 ft., and underground workings aggregate about 175 miles, about half of which are open and in use. The orebodies are well developed, but, owing to heavy ground, it is not advantageous to maintain a large reserve ahead of reasonable requirements.

Surface equipment at the mine is modern and complete. Ore is hauled 25 miles over the El Paso & Southwestern Ry. to the company's smelter at Douglas, Ariz. The smelter treats company and custom ores, and the acid plant has a capacity of about 200 tons, of which approximately 75 per cent is used by the New Cornelia company, at Ajo.

Production of refined copper in millions of pounds has been as follows: 49.9 in 1911, 53.1 in 1912, 52.6 in 1913, 50.0 in 1914, 63.1 in 1915, 70.7 in 1916, 59.1 in 1917, 50.9 in 1918, 45.0 in 1919, 42.4 in 1920, 17.8 in 1921, 30.8 in 1922.

Production cost has been estimated as follows: 7.34c. a pound in 1911, 7.02 in 1912, 7.65 in 1913, 8.19 in 1914, 7.68 in 1915, 9.04 in 1916, 16.7 in 1917, 15.2 in 1918, 14.1 in 1919, 14.3 in 1920, 15.4 in 1921, 15.6 in 1922.

Capital stock outstanding consists of 642,530 shares, par value $10. There is no funded debt. In 1923 the company has about 8,500 stockholders, compared with 7,900 in 1920 and 7,300 in 1916.

Earnings per share have been estimated as follows: $4.23 in 1911, $7.58 in 1912, $6.62 in 1913, $5.00 in 1914, $8.83 in 1915, $17.36 in 1916, $13.06 in 1917, $8.69 in 1918, $2.96 in 1919, $5 in 1920, loss 15c. in 1921, profit $3.96 in 1922.

The dividend record is as follows: $4 in 1911, $4.25 in 1912, $5 in 1913, $3 in 1914, $3.25 in 1915, $9 in 1916, $11 in 1917, $8 in 1918, $3 in 1919, $4 in 1920, $2 in 1921, $2 in 1922. The dividend rate was reduced from $4 to $2 in February, 1921, and again restored to $4 in February, 1923.

Price range of the stock on the New York Stock Exchange during the past six years has been: High, 86¾ in 1919; low, 40 in 1920; closing price, 46, Oct. 15, 1923.

INVESTIGATOR.

MINING STOCKS

Week Ended October 13, 1923

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	...	...	58	June 23, Q	$1.50
Alaska-Br. Col.	N. Y. Curb	...	...	*70	...	....
Alloues	Boston	...	...	*16	Mar. '19	1.00
Anaconda	New York	39	34⅞	35⅜	Se. 15, Oc. 22, Q	0.75
Arcadian Consol	Boston	1⅛	1⅛	1⅛	...	....
Ariz. Com'l.	Boston	8⅛	8⅛	8⅛	July '23,	0.50
Calaveras	N. Y. Curb	...	...	2	...	....
Calumet & Arizona	Boston	47⅜	43⅛	45⅛	Se. 7, Se. 24,	1.00
Cal. & Hecla (New)	Boston	20⅛	17⅛	17⅝	June '23, Q	10.00
Centennial	Boston	...	...	7	Dec. 18, SA	1.00
Cerro de Pasco	New York	39⅜	37⅛	38	Jy. 19, Au. 1	1.00
Chile Copper	New York	27	25⅝	26	Se. 1, Se. 29, Q	0 62½
Chino	New York	17⅜	16⅛	16⅛	Sept. 20, Q	0 37½
Con. Cop. Min. (New)	N. Y. Curb	2	2	2	...	....
Copper Range	Boston	26	24⅛	25⅜	May '23, Q	1.00
Crystal Copper	Boston Curb	66	64	65	...	....
Davis-Daly	Boston	...	...	2⅛	Mar. '20, Q	0 25
East Butte	Boston	5⅛	5	5	Dec. 19, A	0 50
First National	Boston Curb	32	30	30	Feb. '19, SA	0.15
Franklin	Boston	1	*90	1	...	....
Gadsden Copper	Boston Curb	35	35	35	...	....
Granby Consol	New York	16⅛	16	16	May '19, Q	1.25
Greene-Cananea	New York	16⅛	15⅛	15⅛	Nov. '20, Q	0 50
Hancock	Boston	...	...	1⅛	...	....
Howe Sound	N. Y. Curb	2⅞	2⅞	2⅞	Oc 1, Oc. 15	0 05
Inspiration Consol	New York	26⅛	24⅛	24⅝	Se. 13, Oc. 1 Q	0.50
Iron Cap	Boston Curb	3⅜	3⅛	3⅛	May 23, K	0.15
Isle Royale	Boston	20	19⅜	19⅜	Se. 1, Se. 15,	0.50
Kennecott	New York	34	32	32	Se. 7, Oc. 1,	0.75
Keweenaw	Boston	*75	*75	*75	...	....
Lake Copper	Boston	1⅛	1⅛	1⅛	...	....
Magma Copper	New York	28⅜	28⅛	28⅛	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	2	1⅞	1⅞	...	....
Mass Consolidated	Boston	1⅛	1⅛	1⅛	Nov. '17, Q	1.00
Miami Copper	New York	24	22⅝	23⅜	No. 1, No. 15, Q	0.50
Michigan	Boston	1⅝	1⅝	1⅝	...	....
Mohawk	Boston	*39	*37	*38	Se. 22, Oc. 13,	1.00
Mother Lode Coa	New York	8⅛	8⅛	8⅛	Je. 8, Je. 30, Q	0 50
Nevada Consol	New York	12⅜	11	11	Sept. 20, Q	0.25
New Cornelia	Boston	*17⅛	*17	*17	Au. 3, Au. 20, Q	0.25
New Dominion	N. Y. Curb	3	2⅞	3	...	....
North Butte	Boston	1⅜	1⅛	1⅛	Oct. '18, Q	0 25
Ohio Copper	N. Y. Curb	*71	*65	*71	...	....
Old Dominion	Boston	15⅜	15	15	Dec. '18, Q	1.00
Osceola	Boston	...	...	31½	June '23, Q	1.00
Phelps Dodge	Open Mar.	†145	†140	....	Se. 20, Oc. 2 Q	1.00
Quincy	Boston	24	22⅞	23	Mar. '20, Q	1.00
Ray Consolidated	New York	11⅞	11⅛	11⅜	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*58	*35	*39	...	....
St. Mary's Min. Ld.	Boston	33	31	31	Mar. '23, K	3.00
Seneca Copper	New York	7⅞	7⅛	7⅛	...	....
Shannon	Boston	*55	*45	*45	Nov. '17, Q	0.25
Shattuck Arizona	New York	5⅜	5⅛	5⅛	Jan. '20, Q	0.25
South Lake	Boston	...	...	*98	...	....
Superior & Boston	Boston	1¼	1	1⅛	...	....
Tenn. C. & C. cfs.	New York	9⅛	8⅞	8⅝	Se. 29, Oc. 15, Q	0.25
Tuolumne	Boston	1	1	1	May '13,	0.10
United Verde Ex	N. Y. Curb	28⅜	28	28	Oc. 5, No. 1, Q	1.00
Utah Consol	Boston	1⅛	1	1	Sept '18,	0.25
Utah Copper	New York	56⅜	56⅛	56⅜	Se. 14, Se. 29, Q	1.00
Utah Metal & T.	Boston	*65	*55	*65	Dec. '17,	0.30
Victoria	Boston	...	...	*75	...	....
Winona	Boston	*40	*30	*30	...	....
Wolverine	Boston	6⅛	6	6	...	....
NICKEL-COPPER						
Internat. Nickel	New York	11⅞	11⅛	11⅛	Mar.' 19,	0.50
Internat. Nickel pfd.	New York	77⅛	77	77	Oc. 11, No. 1 Q.	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	2⅛	2⅛	2⅛	...	....
National Lead	New York	121¼	116	116	Se. 16, Se. 29 Q	2.00
National Lead pfd.	New York	111	111	111	Au. 24, Se. 15 Q	1.75
St. Joseph Lead	New York	19⅛	19¼	19⅛	Se. 9, Se. 20 Q, X	0.50
ZINC						
Am. Z. L. & S.	New York	8	7⅛	7⅛	May '20,	1.00
Am. Z. L. & S. pfd.	New York	...	...	26	Nov. '20, Q	1.50
Butte C. & Z.	New York	5⅜	5	5	Mar. '23,	0.50
Butte & Superior	New York	14⅛	13⅛	13⅛	Je. 15, Je. 30, Q	0.50
Callahan Zn-Ld	New York	4⅜	4	4	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	144¼	144¼	144¼	Oc 31, No. 10, Q	2.00
United Zinc	N. Y. Curb	...	...	*50	...	....
Yellow Pine	Los Angeles	...	...	*70	June '23, Q	0.03
SILVER						
Alvarado	N. Y. Curb	...	...	1⅛	...	....
Batopilas Mining	New York	...	...	½	Dec. '07, I	0.12½
Beaver Consol	Toronto	*31	*29½	*29	May '20, K	0.03
Candelaria	N. Y. Curb	*6	*5	*5	...	....
Castle-Trethewey	Toronto	*32½	*30	*30½	...	....
Coniagas	Toronto	2.40	2.40	2.40	May '21, Q	0.12½
Crown Reserve	Toronto	*66	*62	*64	Jan. '17,	0.05
Hilltop-Nev	N. Y. Curb.	*4	*3	*4	...	....
Kerr Lake	N. Y. Curb	2⅜	2⅛	2⅜	Oc. 1, Oc. 15, Q	0.12½
La Rose	Toronto	*25	*25	*25	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*15	*12½	*13	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	3.19	3.05	3.05	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	5⅜	5⅛	5⅜	Se. 3, Oc. 17. Q	0.30
Ontario Silver	New York	6⅛	5⅛	6⅛	Jan. '19, Q	0.50
Temiskaming	Toronto	*36	*34½	*35	Jan. '20, K	0.04

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	⅛	⅛	⅛	...	....
Alaska Juneau	New York	⅛	⅛	⅛	...	....
Boundary Red M.	N. Y. Curb	...	...	*12	...	....
Carson Hill	Boston	3⅛	3	3⅛	...	....
Cresson Consol. G.	N. Y. Curb	3¼	3 11/16	3 11/16	Se. 30, Oc. 10, Q	0.10
Dome Mines	New York	38⅛	37⅛	37⅛	Oc. 12, No. 1, Q	1.75
Golden Cycle	Colo. Springs	1.10	1.09½	1.09½	Dec. '22, Q	0 02
Hollinger Consol.	Toronto	11.60	11.35	11.35	Oc. 18, No. 25, M	0.05
Homestake Mining	New York	62½	61½	61½	Oc. 20, Oc. 25 M	0.50
Kirkland Lake	Toronto	*41	*39	*39	...	....
Lake Shore	Toronto	3.37	3.35	3.35	Au. 1 Au. 15 '23, Q	0.02
McIntyre-Porcupine	New York	16⅝	15⅝	16⅝	Au. 1, Se. 1, Q	0.25
Portland	Colo. Springs	...	...	*35	Oct. '20, Q	0.01
Teck-Hughes	N. Y. Curb	1⅜	1 1/16	1 1/16	...	....
Tom Reed	Los Angeles	*53	*53	*53	Dec. '19,	0.02
United Eastern	N. Y. Curb	1 1/16	1½	1½	Oc. 8, Oc. 28, Q	0.15
Vipond Cons.	Toronto	*96	*89	*89	...	....
Wright-Hargreaves	Toronto	3.05	3.00	3.00	Se. 15, Oc. 1, Q	0.02½
Yukon Gold	N. Y. Curb	*81	*81	*81	June '18,	0.02½
GOLD AND SILVER						
Boston-Mont. Corp.	N. Y. Curb	*14	*12	*13	...	....
Con. Cortez	N. Y. Curb	*50	*43	*50	...	....
Con. Virginia	San Francisco	11⅛	8⅛	9⅛	...	....
Continental Mines	N. Y. Curb	4⅞	4¼	4⅜	...	....
Dolores Esperanza	N. Y. Curb	1	*90	*92	Jy. 1, Jy. 10 Q	0.05
Jib Consol	N. Y. Curb	...	...	*65	...	....
Tonopah Belmont	N. Y. Curb	...	...	*64	Apr. '23, Q	0.05
Tonopah Divide	N. Y. Curb	...	...	*42	Se. 22, Oc. 10	0.10
Tonopah Extension	N. Y. Curb	2	2	2	Se. 10, Oc. 1	0.05
Tonopah Mining	N. Y. Curb	1 1/16	1 1/16	1 1/16	Se. 30, Oc. 1	0.07½
Unity Gold	N. Y. Curb	3⅛	2⅞	3⅛	...	....
West End Consol.	N. Y. Curb	*76	*75	*75	Mar. '23, Q	0.05
SILVER-LEAD						
Bingham Mines	Boston	...	...	16½	Sept. 19, Q	0.25
Cardiff M. & M.	Salt Lake	*80	*80	*80	Dec. '20,	0.15
Chief Consol.	Boston Curb	3⅛	3⅛	3⅛	Au. 1, '23, Q	0.10
Columbus Rexall	Salt Lake	*37	*35	*36	Aug. '22,	0.03
Consol. M. & S.	Montreal	26⅛	25⅛	26⅛	Oct. '20, Q	0.62½
Erupcion	Boston Curb	2⅛	2⅛	2⅛	Se. 15, Oc. 2	0.125
Federal M. & S.	New York	...	...	9	Jan., '09,	1.50
Federal M. & S. pfd.	New York	40	39	40	Au. 25, Se. 15,	1.75
Florence Silver	Spokane	*17	*16½	*17	Apr. '19, Q, X	0.01½
Hecla Mining	N. Y. Curb	8⅛	8⅛	8⅛	Au. 15, Se. 15	0.15
Iron Blossom Con.	N. Y. Curb	*32	*31	*31	July 16,	0.02½
Marsh Mines	N. Y. Curb	*10	*9	*10	June '21, I	0.02
Park City	Salt Lake	3.20	3.20	3.20	Se. 15, Oc. 1 Q	0.12½
Park Utah	N. Y. Curb	....	....	3	Se. 15, Oc. 1 Q	0.15
Prince Consol.	Salt Lake	...	...	*⅜	Nov. '17,	0.02½
Silversmith	Spokane	*35	*33½	*35	Oc. 1, Oc. 10	0.01
Simon Silver-Lead	N. Y. Curb	....	....	*15	...	....
Snowstorm Silver-L.	N. Y. Curb	...	...	*45	...	....
Tamarack-Custer	Spokane	1.40	1.38	1.40	Je. 30, K	0.02
Tintic Standard	Salt Lake	3.52½	3.35	3.50	Se. 24, Se. 29	0.15
Utah-Apex	Boston	3	2⅞	3	June '23, Q, X	0.50
IRON						
Bethlehem Steel	New York	49½	46	46½	Se. 1, Oc. 1 Q	1.25
Char. Iron	Detroit	¾	¾	¾	...	....
Char. Iron pfd.	Detroit	1½	1½	1½	...	....
Colorado Fuel & Iron	New York	27	25⅛	25⅛	Au. 10, Au. '25 Q	2.00
Col. Fuel & Iron pfd.	New York	...	...	102	Feb. '23, Q	2.00
Gt. North'n Iron Ore	New York	29	28	28⅛	Apr. '23	1.00
Inland Steel	N. Y. Curb	...	...	46½	Au. 15, Se. 1 '23 Q	0.62½
Mesabi Iron	N. Y. Curb	...	...	5	...	....
Replogle Steel	New York	10	9	9	...	....
Republic I. & S.	New York	44	42⅛	43	May '21	1.50
Republic I. S. pfd.	New York	85⅜	85⅛	85⅛	Se. 15, Oc. 1 Q	3.75
Sloss-Sheffield S. & I.	New York	42	40	40	Se. 2, Oc. 1 Q	1.75
Sloss-Shef. S. & I. pfd.	New York	...	...	78	Je. 22, Jy. 2 Q	1.75
U. S. Steel	New York	88⅛	86	86⅜	Au. 30, Se. 29, Q	1.25
U. S. Steel pfd.	New York	119⅛	118⅛	118⅜	Au. 7, Au. 30 Q	1.75
Virginia I. C. & C.	New York	...	...	54	Je. 16, Jy. 2	2.00
Virginia I.C.&C. pfd.	New York	81	81	81	Je. 16, Jy. 2	2.50
VANADIUM						
Vanadium Corp.	New York	28⅛	27⅛	27⅛	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	45⅛	44	45⅜	Se. 29, Oc. 15 Q	1.00
Asbestos Corp. pfd.	Montreal	70	70	70	Se. 29, Oc. 15 Q	1.50
SULPHUR						
Freeport Texas	New York	12⅛	11	11⅛	Nov. '19, Q	1.00
Texas Gulf	New York	58⅛	56¼	56⅛	Se. 1, Se. 15 Q	1.50
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	....	....	4	...	....
MINING, SMELTING AND REFINING						
Amer. Metal	New York	43⅜	42⅛	42⅛	Au. 20, Se. 1	0.75
Amer. Metal pfd.	New York	...	...	107⅓	Au. 18, Se 1	1.75
Amer. Sm. & Ref.	New York	59⅜	55	55	Oc. 11, No. 1, Q	1.25
Amer. Sm. & Ref. pfd	New York	97⅛	97	97⅛	No. 9, De. 1,	1.75
U. S. Sm. R. & M.	New York	23¼	20⅞	20⅞	Jan. '21, Q	0.50
U.S. Sm.R.& M. pfd.	New York	40½	40⅛	40½	Oc. 8, Oc. 15 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Arthur E. Moysey; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.

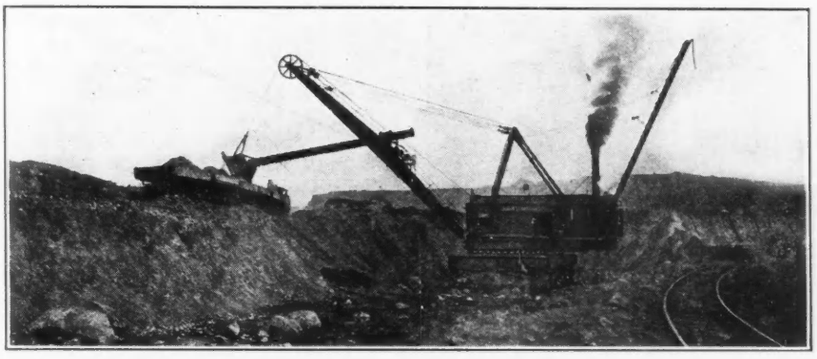
New Machinery and Inventions

Equipment and Methods on the Mesabi Iron Range

Rapid Development of Excavating, Loading, and Transporting Machinery to a High Degree of Efficiency Has Taken Place

By Charles Pierce Burton

THE DEVELOPMENT of stripping machinery has kept pace with the increasing demand for steel, as will be shown by a study of methods adopted by the Oliver Iron Mining Co. in its operations on the Mesabi iron range. The Oliver company is the iron-mining subsidiary of the U. S. Steel Corporation. In the operations on the range probably more material is being moved by steam shovels than anywhere else on the face of the earth, even exceeding the quantities moved in Panama Canal work during the busiest period of construction. Economical methods for quantity production on a vast scale have been devised, with plenty of capital for experimental purposes.



Large revolving shovel with 8-yd. dipper loading Western dump cars in stripping

The first stripping on the range was done with teams and scrapers, or with wagons loaded by hand. When dump cars first were used in a small way, 1-cu.yd. cars were hauled by team. This was found inadequate to meet the increasing demand for stripping, and dinky locomotives were substituted for teams. Then came 3-yard dump cars pulled by 8- and 9-ton locomotives and loaded by 40-ton shovels and 1½-yard dippers. Still the demand continued to increase and 4-yard cars were installed, with 10- and 15-ton locomotives and still larger shovels. Finally the Oliver company adopted a 7-yard dump car, and it became the talk of the range. A 7-yard dump car up to that time had been almost unthinkable and was believed to be the last word in car construction.

However, the evolution continued rapidly. Standard-gage equipment and 2-yard dippers followed, with 73-ton locomotives and 70- to 75-ton shovels. Then came still heavier shovels and 2½-yard dippers, although used with the 7-yard cars. The first 12-yard dump cars on the range were installed by the Mahoning Ore & Steel Co. and at last accounts were still in service somewhere in northern Minnesota. They were the first Western 12-yard cars built. The increase in the size of dump cars required greater power, and 105- to 107-ton locomotives gradually made their appearance.

Still the cry was for larger cars. Sixteen-yard cars were installed, the larger size having been made possible by the invention of the now standard air-dumping device; then 20-yard cars, used with 136-ton locomotives, 138-ton shovels and 5-yard dippers. The present 360-ton shovels of the revolving type, with 8-yard and even 10-yard dippers, represent the high-water mark of development in this direction.

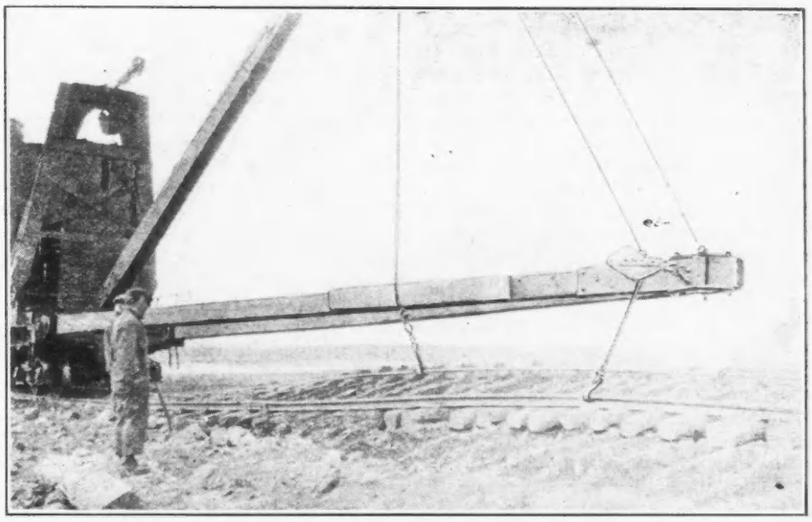
The Oliver Iron Mining Co. has complete blacksmith and machine shops in every operating division on the range, where locomotives, steam shovels and dump cars can be rebuilt from the foundation, if desired. The practice of the company has been to strengthen its equipment in these shops and to suggest to the manufacturing companies modifications and reinforcements required in their intensive operation.

One of the dumps at Eveleth, showing type of bents used in trestle construction

Several years ago the company undertook an important experiment with large dump cars, to develop a type adapted to the exceedingly heavy work on the range. Five different makes were selected for the tests, and ten 20-yard cars of each make were purchased and put into active stripping service, in an endeavor to find the breaking point. "We drop a weight of fifteen tons from a distance of seven to eight feet into a dump car," said the engineer, "and then wonder why the car breaks." "As a matter of fact," he continued, "no man can design a car on paper which will stand the strain. We have to keep on breaking them and thus find out their weak points."

So the company kept on breaking cars until the weak points were discovered and then those weak points were strengthened or eliminated. As a result of the test, which covered many months, the Western automatic compression lock 20-yard air-dump car was developed and installed in large numbers.

However, no sooner were the 20-yard cars well warmed up to their work than



Machine for shifting tracks, used on the range

the Oliver engineers, still experimenting, asked for a 30-yard, with some modification in the design. With their co-operation, a 30-yard, automatic compression lock air-dump car was designed by the Western Wheeled Scraper Co., somewhat strengthened to meet the grueling range conditions. Fifty of these cars were promptly put into service, and a second order of one hundred is now being installed. This improved 30-yard car is in such general use that it may be regarded as the Range type, and it really seems to be the last word in dump-car construction.

"What is your main problem in stripping?" the pit superintendent of the Oliver Iron Mining Co. at Virginia, Minn., was asked.

"To keep a string of empties coming up to the shovel," was the reply.

At that time two shovels were stripping the Virginia mine and two taking out ore, and every effort was made to keep a "string of empties coming." The boom of the huge shovel swings once every minute. A gap of only five minutes between trains, therefore, would mean a stripping loss of 40 cu.yd., which does not conform to the Oliver Iron Mining Co.'s idea of efficiency.

"The only way to figure the expense of delay," explained the pit superintendent, "is on a production basis and not on a cost basis. The cost of operating a 4-yard shovel, including depreciation, etc., at the present time is about $7.50 per hour, 12½c. per minute. On that basis a delay of a few minutes does not seem so expensive, but we figure that delaying a shovel 10 minutes costs us $10 at least, and it does, on a production basis, which is the only way to figure it."

The cost of delay was illustrated in a most striking way at Virginia some years ago. The Oliver company was taking water for its shovels there by syphon from locomotives. The district manager desired to put in water pipes—a base line from the supply with branches of 1¼-in. pipe running to each shovel. Pipe was exceedingly hard to get at that time and the officers of the company at Duluth had to be "shown."

The district manager and his pit superintendent "burned midnight oil" figuring the cost of delay resulting from their method of taking water, figuring it on a production basis. The cost of pipe and installation was figured against the cost of syphon hose, etc. The result astonished even the district manager and nearly paralyzed the general officers. The net loss in operating time during a three-months' period, for three shovels, on a production basis, proved to be about $27,000. Needless to say the pipe line was installed.

To keep the shovel going, the two important factors on the range are run-arounds and plenty of empties. In laying out a pit, a superintendent should be able to see six months ahead and see what the conditions will be then.

"It is possible to spoil a pit with one cut," explained the superintendent, "by cutting out your benches in such a way that you cannot get to the point where you want to tie in your tracks."

An ideal pit opening, according to the superintendent, would be to cut around the stripping area and then cut through the center, say twice, giving place to work a number of shovels. In ordinary steam-shovel operation the shovel is cut in to proceed to greatest advantage, but often in mining, the pit must be cut in where the overburden is shallowest, so that ore may be reached at the earliest possible moment.

Usually there must be one approach for overburden and another for ore, although sometimes, as is the case at the Missabe Mountain pit at Virginia, the same approach is used for both. It is the usual practice on the range to lay the first track on rough ground when cutting-in a shovel, loading the first cut into cars instead of casting. The proper loading condition in both stripping and mining is to have an empty

Tamping ties with compressed air at Eveleth

train moving into position under the shovel as the loaded train moves out on the opposite side. Whenever possible this is accomplished by run-arounds: trains come in at the main entrance, diverge to the several shovels, and pass out of the pit the other way by means of run-around tracks.

There are two arrangements for the final track, a series of switchbacks and a system of spirals. The spiral method was in general use some years ago, but is now considered to tie up too much ore in the benches. Main-line grades, as a rule, do not exceed 1½ per cent, over which a locomotive with 19x26 cylinders can haul about 460 tons.

The depth to which a pit can be stripped advantageously depends upon the thickness of the orebody and of the grade out of the pit in the final track arrangement. A grade beyond 5 to 6 per cent is not considered practicable. At Virginia, loaded ore cars, holding about 50 tons each, are pushed out of the pit around the curve up a 4 per cent grade in trains of four cars. There is about 40 ft. of stripping and the orebody is 300 ft. deep in the deepest place. The company may have to go underground in the deepest part on account of the grade out of the pit. Theoretically, under favorable conditions, it is thought profitable to strip four feet of overburden for every foot in depth of ore, although two for one is nearer the practice.

As a matter of fact, there are three methods of mining on the range, their use depending upon local conditions—underground, open-pit, and milling, which last is a combination of the other two. The milling method is used to some extent by the Oliver company at Eveleth. In milling, a hoisting shaft is sunk well out of the way of the orebody and a part of the orebody is stripped. Raises are constructed 40 to 50 ft. apart, reaching from the drifts below to the stripped surface, each provided with a strong chute. The ore is mined into these raises, loaded into small cars in the drifts below, and taken to the hoisting shaft.

The dump, of course, is placed beyond the orebody, and grade crossings are avoided if possible in reaching it. The Oliver company considers it better to run trains an extra mile than to have a grade crossing, with the added risk of personal injury. At Virginia, for example, the dump at the time it was recently visited by the writer, required 7½ miles for the round trip. Trains were averaging six round trips per ten-hour day, the maximum grade being 2½ per cent. At Eveleth the grade was only 1½ per cent and larger trains were operated. Double tracks are laid to the dumps, built with 80-lb. steel and kept in excellent condition.

The greater part of the stripping is left until winter, after the season of navigation has closed. Then the shovels are taken out of the ore and every effort is made to uncover ore for future mining.

Comparatively little blasting is necessary in summer stripping. Most of the overburden is glacial drift, with frequent boulders from 2 to 6 ft. in diameter. In winter, however, when the banks sometimes freeze to a depth of 8 ft., the overburden has to be shot. One blaster and four men in front of each machine keep both shifts going.

At Virginia, winter drilling is done with steam jets through a pipe with a hose attachment leading from the shovel. This method works in all kinds of material except rock and gravel, and gravel does not freeze into a compact mass. The thawing process is so rapid that the pipe can be seen to move into the bank. If the pipe meets a boulder it is necessary to change to a new spot, but this is true also when working with a pointed drill, heated. Sometimes drill holes are put in from 3 to 5 ft. deep and blasted with light charges before freezing sets in. Loosening the ground in this way prevents hard freezing.

In blasting a 25-ft. bank, from 15 to 25 sticks of dynamite are used to spring the hole and the hole then is filled with from five to ten 25-pound kegs of black powder. The holes are drilled 20 to 25 ft. apart, to a depth varying with the cut. They are fired in batteries of from three to five at a time. It is customary to make the horizontal distance between the center of the loading track and the chamber of the hole from 5 to 6 ft. less than the reach of the shovel. Often the cars are sprinkled, through a hose, with hot solutions of salt and water to prevent freezing.